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The Casket's
New Anatomical Plates

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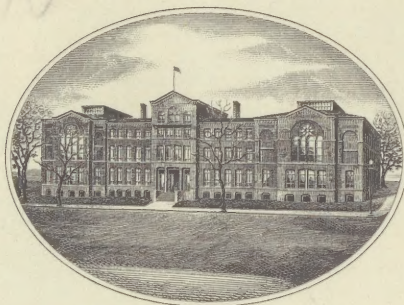
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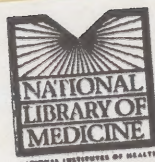
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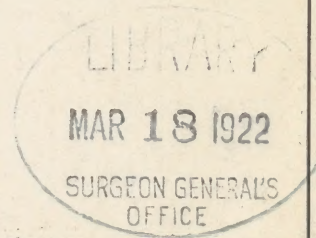
The Casket's New Anatomical Plates

*Drawn With Special Reference to the
Requirements of Embalmers*

Under the Direct Supervision of
PROF. CHARLES A. RENOUEARD



NEW YORK:
THE CASKET, Inc.
1921



Dead, Disposal of (1921)

The Casket, Inc.

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PREFACE



In the absence of constant practice, even the best of memories cannot retain a clear image of that most intricate of natural mechanisms, the human arterial and venous systems. The average embalmer, finding himself confronted, in the main, with cases of only average difficulty is apt to permit his knowledge of the vascular system, as learned at school, to become tarnished with the lapse of time, and when a case presenting problems differing from his usual run of work comes up, often finds himself at sea.

Text books and quiz compends there are aplenty; but even the most lucid descriptions fail in the vital matter of laying before the searcher for information, a detailed visualization of the body parts to be worked upon and the channels through which his fluid must pass in order to secure the objective of perfect preservation of the tissues.

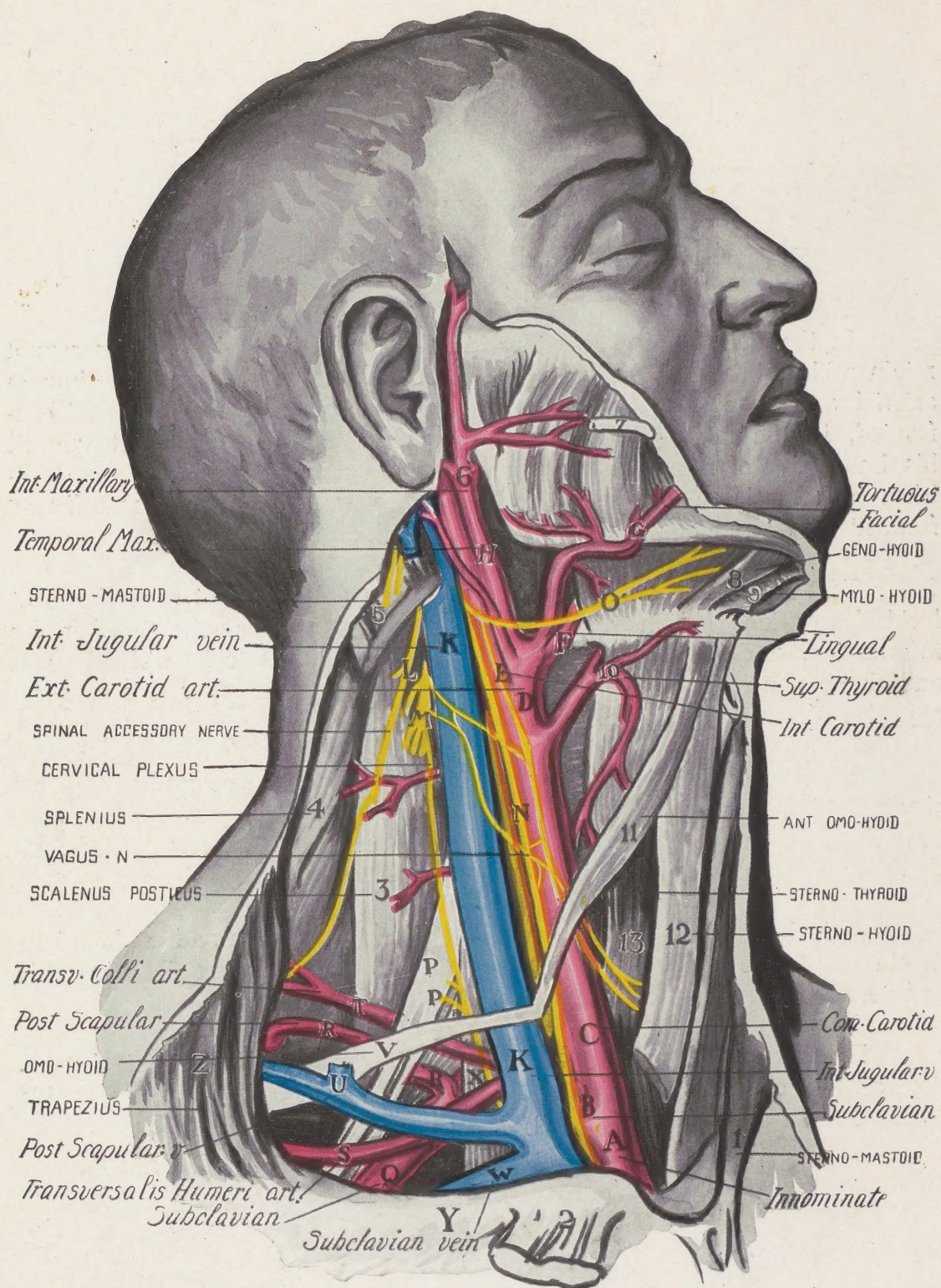
It was for the purpose of meeting this need that the colored anatomical charts in this book were designed. Each chart is accompanied by a brief, but comprehensive, explanation from which all but the most essential information for the embalmer has been rigorously excluded.

It is believed that frequent reference to the charts and explanations herein will serve to keep the practicing embalmer's memory of the arterial and venous systems as fresh as on the day of his graduation.

For the student, nothing can be of greater help than constant observation of the charts, thereby supplementing his class-room exercises in his leisure hours.

CHARLES A. RENOUEARD

Plate No. 1. ARTERIES AND VEINS OF THE NECK



The arteries and veins located in the neck, commonly used by some embalmers. C—Common carotid artery. D—External carotid. B—Internal carotid, with other branches, such as the facial and cranial branches. K—Internal jugular vein. W—Subclavian vein.

Plate No. 1. ARTERIES AND VEINS OF THE NECK

In the early history of the medical profession, instruction in anatomy was retarded to a very great extent by lack of anatomical material, due, no doubt, to prejudice on the part of the public regarding the dissection of bodies for scientific purposes. Later, when laws were enacted, giving medical schools and universities certain unclaimed bodies, it was customary to prepare these bodies for future use in the dissecting rooms.



PROF. CHARLES A. RENOUARD

In order to facilitate the dissection of the various blood vessels, injection of plastic colored solutions was resorted to, red being injected into the arteries, and blue into the veins. Before these colored preparations were injected, preserving solutions were employed to preserve the body from putrefaction while lying on the dissecting tables.

As it was desired not to mutilate any part of the body that would interfere with the education of the medical student, the carotid artery was selected as a point for injection, this being considered the most desirable part of the body. When instruction in the art of embalming was first attempted in this country, it was natural to select the same artery that had been used by the medical schools in the preparation of their anatomical material. Thus the carotid artery was the first used in the early days of embalming. Later experiments led to the use of other arteries which will be spoken of in detail later on in this series of articles.

Regardless of the great advances made in the technique of embalming, some embalmers still continue to use the common carotid artery, preferably that on the right side of the neck. Of late years the introduction of formaldehyde into the preserving solutions employed by embalmers has resulted in many varying conditions, especially in the passage of these solutions into the head, when the carotid was used as a point for injection. These varying conditions caused considerable comment and a strong desire to ascertain the underlying causes of the varying and unequal distribution of preserving solutions to both sides of the face and head.

A glance at the accompanying anatomical plate, showing the large common carotid artery marked C, with its branches, the external and internal carotids, marked, respectively, D and E, will clearly show why (when the circulation of preserving solutions is interfered with by opening the common carotid artery for the purpose of injecting the solution), the fluid is unequally distributed to each side of the face and head in like amounts.

If the reader will note the branches given off by the external carotid artery (marked D, F, G, H and 6), he will readily understand why the fluid cannot pass into the face and head with any degree of equality. If the right carotid is employed and the injection is made downwards, as is customary, more fluid will pass up through the left carotid artery, which has not been opened, and the left side of the head and face will receive an amount of fluid in excess of that distributed to the right side. Again, if the embalmer injects the right carotid artery upwards, after the lower part has been injected, he may either use more fluid or the pressure may be greater near the point of injection, and this will contribute to a larger amount of fluid passing into the right side of the head and face than what passed into the left. Again, if the upper part of the right carotid artery is allowed to remain open until the flow of fluid from the upper cut end indicates a circulation of fluid through the Circle of Willis, down through the internal carotid and lastly through the common carotid, and the artery is then tied, the amount of fluid in the left side of the head will be greater than on the right side.

This unequal distribution of fluid will cause one side of the head and face to become harder than the other. If the fluid injected downwards into the common carotid on the right side passes into the body, and then upwards through the left common carotid and its branches, through the brain, the fluid will pass downwards through the internal right carotid and escape at the point where the opening was made for injection. If the embalmer then ties this part of the artery, the fluid may not pass upwards through the external carotid artery and its branches (marked D, H, G and 6), thus leaving the external part of the right side of the face and head unprotected by preserving solution, and putrefaction will soon follow.

These are the main reasons why so many embalmers complain that one side of the head is very hard and over-preserved, while the other is soft and shows a lack of preserving fluid. If the carotid arteries must be used, it is best to inject both common carotids upwards with the same amount of fluid so as to insure equal distribution to each side of the face and head.

Another reason for the use of other arteries by modern embalmers is this: The mutilation of the neck is undesirable; it jars upon the sensibilities of the relatives of the deceased. The opening in the neck is too suggestive of suicide by cutting the throat, and if a garment is used that is not cut high in the collar, the scar may be hard to conceal. Another reason for the use of other arteries is, when the neck is short and full-blooded, the raising of the carotid artery involves severing venous branches, unless great care is taken by the operator, thus resulting in a hemorrhage of blood which interferes with

the work of the embalmer, and causes staining of the bed and other clothing with blood.

If an autopsy has been performed the injection of the severed ends of the common carotids or even the internal and external branches may be carried out with less annoyance than when otherwise employed. The above reasons may be advanced for the discontinuation of the carotids at points for injection by modern embalmers. If other arteries located in various parts of the body are employed, the above disadvantages are not encountered.

As the head is a part of the body always exposed to public view, it is very important that the appearance of each side of the face should be uniform. There is no use of constantly complaining of the unequal preservation of both sides of the face and head, if we persist in the use of the carotid artery on either side. There are so many superior points of injection that are now employed that the embalmer is at fault if he persists in flirting with failure by continuing the use of an arterial branch that was discarded by progressive embalmers years ago.

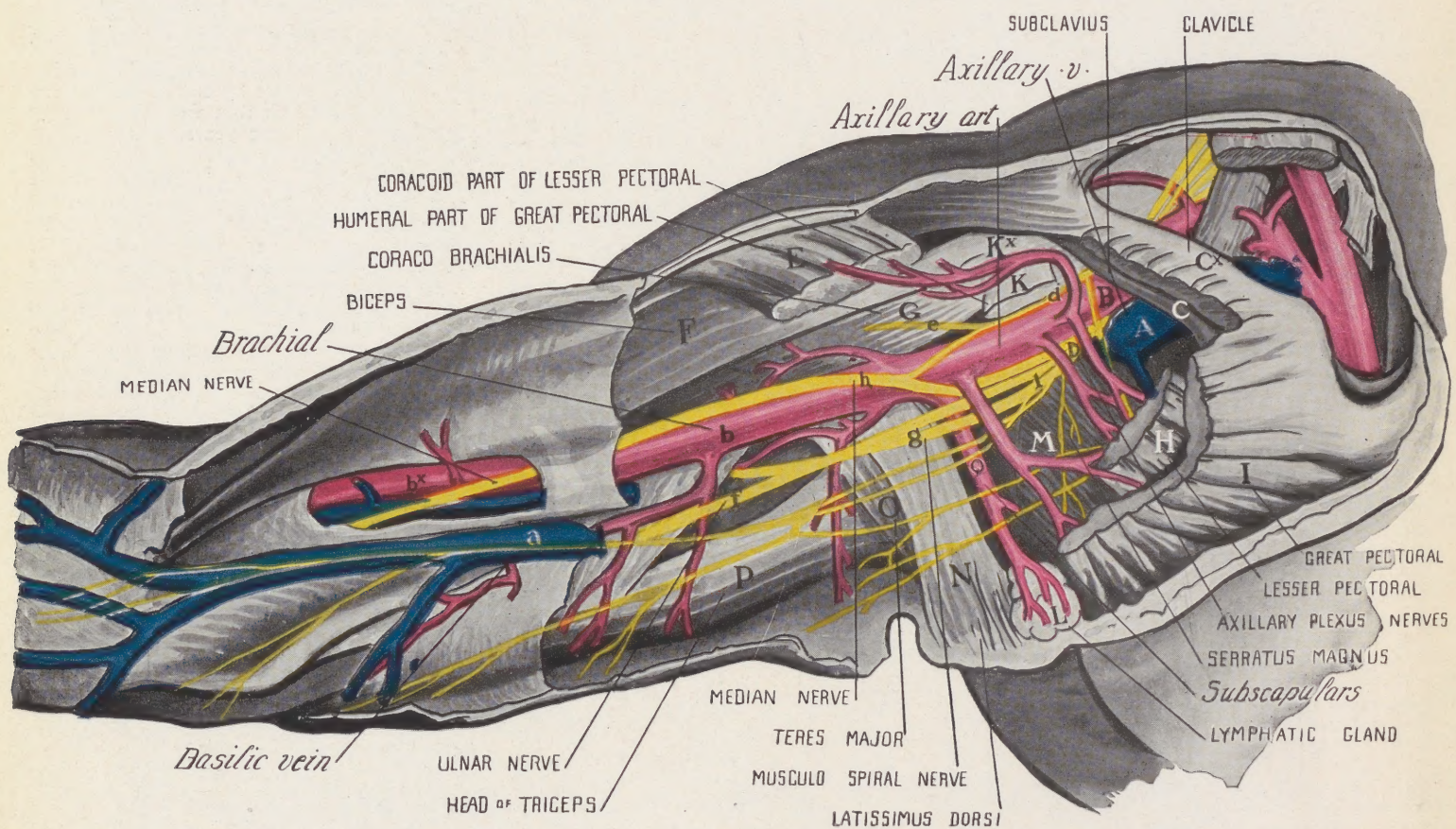
The main cause of so many failures can be laid at the door of those who try to perform work in which they have never had any proper training. If embalmers were better trained in the most important part of the undertaking profession, there would not be so much complaint about failures. So many untrained operators endeavor to perform operations that they have acquired from some other fellow, without knowing why it is being done, that it is a wonder there are not more failures recorded. If these same persons would take advantage of the training schools now conducted, where there are unlimited facilities for acquiring a theoretical as well as a practical education, where there are numerous fresh bodies provided for embalming, and afterwards kept on exhibition for their continuous inspection, thus enabling them to see for themselves the various changes produced by the action of the embalming preparations employed, together with the latest technique which they are made to perform under the guidance of expert teachers, they would be doing themselves a great favor. To thoroughly understand what these wonderful advantages mean, the student must be required to perform the work himself, so as to be in a position to judge of his ability to perform the same operations in his everyday practice.

Embalming is easy if the operator has received a thorough training in all branches of his work, and especially if he is inspired with confidence in his own ability, by having treated, while at school, cases in an advanced state of putrefaction.

What makes the successful embalmer of today, the one who has faith in his ability to do things that the ordinary embalmer claims are impossible, is the man who has been trained in the actual work which he has performed in difficult cases under the guidance of competent instructors, and who, above all, is allowed to keep these treated cases for a number of days in a room where the temperature is from 70 to 80 deg. F. and note the results of his work. This sort of training is what inspires a man with confidence in his ability to do when at home, what he was made to do while at school.

Plate No. 2.

ARTERIAL AND VENOUS BRANCHES OF THE ARM



The arteries and veins located in the upper arm, used by embalmers for injecting fluid and removing blood. The brachial artery has long been used by embalmers as a point for injecting fluid (marked b), and the basilic vein (marked a), for the removal of blood by means of the improved basilic vein tube. The brachial artery gives off branches such as the superior and inferior profunda brachialis and the anastomotica magna arteries.

Plate No. 2.

ARTERIAL AND VENOUS BRANCHES OF THE ARM

As progress was made in the science of embalming, the art was also improved. The brachial artery was selected as a point for injection by the more progressive embalmers of the time, and this point became generally recognized as superior to that of the carotid. There were many reasons why the brachial artery should be used in preference to the carotid. In the first place it did not mutilate an exposed portion of the body; it did not cause an unequal distribution of fluid to one part of the body to the detriment of another. Its position was favorable on account of its easy location, and the fact that there was not an abundance of fat to work through. Again, the injection of fluid into the brachial permitted of a uniform distribution of fluid to both sides of the head, as well as other parts of the body. An incision made in the arm for the purpose of using the brachial artery could not be objected to on the ground of mutilation. The use of the brachial artery was also favorable on account of its close proximity to the basilic vein from which blood could be easily removed, and all this from a small incision of one inch in length.

The colored illustration will reveal its desirability at a glance. We see the brachial artery and its branches represented in red. The artery is lettered "b" and lies partially under the median nerve "h" in the upper part of the arm, and outside of this nerve in the lower part near the bend of the elbow. The basilic vein which is lettered "a" and which has been cut off in order not to conceal the various branches given off by the brachial artery, passes upwards following the inner border of the triceps muscle and accompanied by the cutaneous nerve.

This vein is used to pass the improved basilic vein tube into so as to reach the right auricle of the heart for the purpose of draining blood from the terminus of the venous circulation, and in this manner relieve the blood from all parts of the body.

As the carotids and jugulars are not interfered with when the brachial artery is used as a point for injection, the fluid passes upwards through these arteries and supplies both sides of the head and face equally. The ease with which this artery can be located and raised has made it a favorite point for the embalmer to inject his preserving solution. If formaldehyde preparations are employed by the embalmer, the brachial artery enables him to inject without having any difficulty in respect to the proper position the arm should afterwards occupy.

Some embalmers complain that the shoulder and neck become enlarged and hard very soon after the injection is commenced, but this condition may be attributed to the hasty injection of the fluid, as well as the astringent properties of the fluid employed. This latter property of formaldehyde has caused many manufacturers of fluid to advocate the injection of what is commonly called a "wash solution" which is first injected to saturate the tissues, as they call it, and this wash solution is followed by a strong solution, which is intended to preserve the tissues in a manner that the wash solution evidently could not, owing to its weakness.

For many years the brachial artery was employed in conjunction with the cardiac needle which was introduced directly into the right auricle of the heart, but soon many

blood draining tubes made their appearance on the market and after many years of experimenting, and the elimination of many of these tubes, the number dwindled to a few which are now employed with more or less success.

The brachial artery and basilic vein are raised in the upper part of the arm, and from this point the fluid is injected and the blood removed. The fact that the fluid can be injected from this point and the blood removed from the same incision has made this point a most desirable one. When the brachial artery was first used as a point for injecting fluid, we had no formaldehyde preparations on the market, and the hardening of the body was a thing not thought of. But it will be remembered by many old undertakers and embalmers that we did not have to paint the face with paint and powder as is done today. At that time we had natural looking cases, and they were as flexible as during life, and as for failures, there were less than at present. If the family desired the position of the body changed after it had been placed in the casket, it was easily accomplished. Therefore, the use of the brachial was considered an ideal location for injecting the preserving fluid.

The colored plate will show the many lateral branches that take care of the surrounding muscles as well as to permit the flow of fluid into the lower part of the arm below the point of injection. It sometimes happens that the fluid does not pass through these lateral branches owing to the strong astringent properties of the fluid, and then the lower part of the arm undergoes partial putrefactive changes, which are discovered by the embalmer when the body is being dressed, by the skin becoming detached. This is commonly known as skin-slip and is an indication of incipient decay. Should the artery be tied before the injection is completed, there will be no way of ascertaining if any fluid has passed into the circulation of the lower part of the arm.

It is for this reason that the artery is not tied until the entire operation is completed. If no fluid escapes from the lower part of the brachial artery, after the operation is completed, the brachial is injected downward so as to supply fluid to the lower arm and hand. If this is always attended to there will be no necessity for placing the "good" hand over the other to conceal the changes that are taking place due to a lack of preserving fluid.

The right brachial artery is usually selected by the embalmer, although some use the left side, they being left handed. Others use the left side, being under the impression that it is easier to pass the basilic vein tube into the right auricle of the heart, but this is not true, for the improved basilic vein tube can be used from the right side as well as from the left.

A few words in regard to the passage of the blood tube into the right auricle of the heart. If you will consult the colored plate you will notice that the axillary vein marked (A) passes over the first rib and under the clavicle marked (Cx) when it becomes the subclavian vein. The subclavian vein receives both of the jugular veins to form the vena innominata. If the tube is not properly directed it will not follow the course of the

veins through which it has to pass in order to reach the right auricle of the heart.

There is much complaint by embalmers as to the impossibility of passing the various blood tubes into the veins. None of the blood tubes is fool proof. If anybody attempts to perform a certain operation that he knows very little about, he will surely experience difficulties that a trained embalmer will not have to his credit. To properly use a blood tube, it is necessary that the operator have a clear knowledge of the course these veins follow in order to properly direct the tube through their channels. When we have students, many of whom have had years of experience in embalming, we are amazed at their lack of knowledge in many of the simplest requirements of the calling. We provide them with fresh bodies, and request them to pass the blood tube into the right auricle of the heart from both the left and right sides of the bodies we are working on, as well as require the removal of blood with these tubes after they have introduced them into the right auricle of the heart.

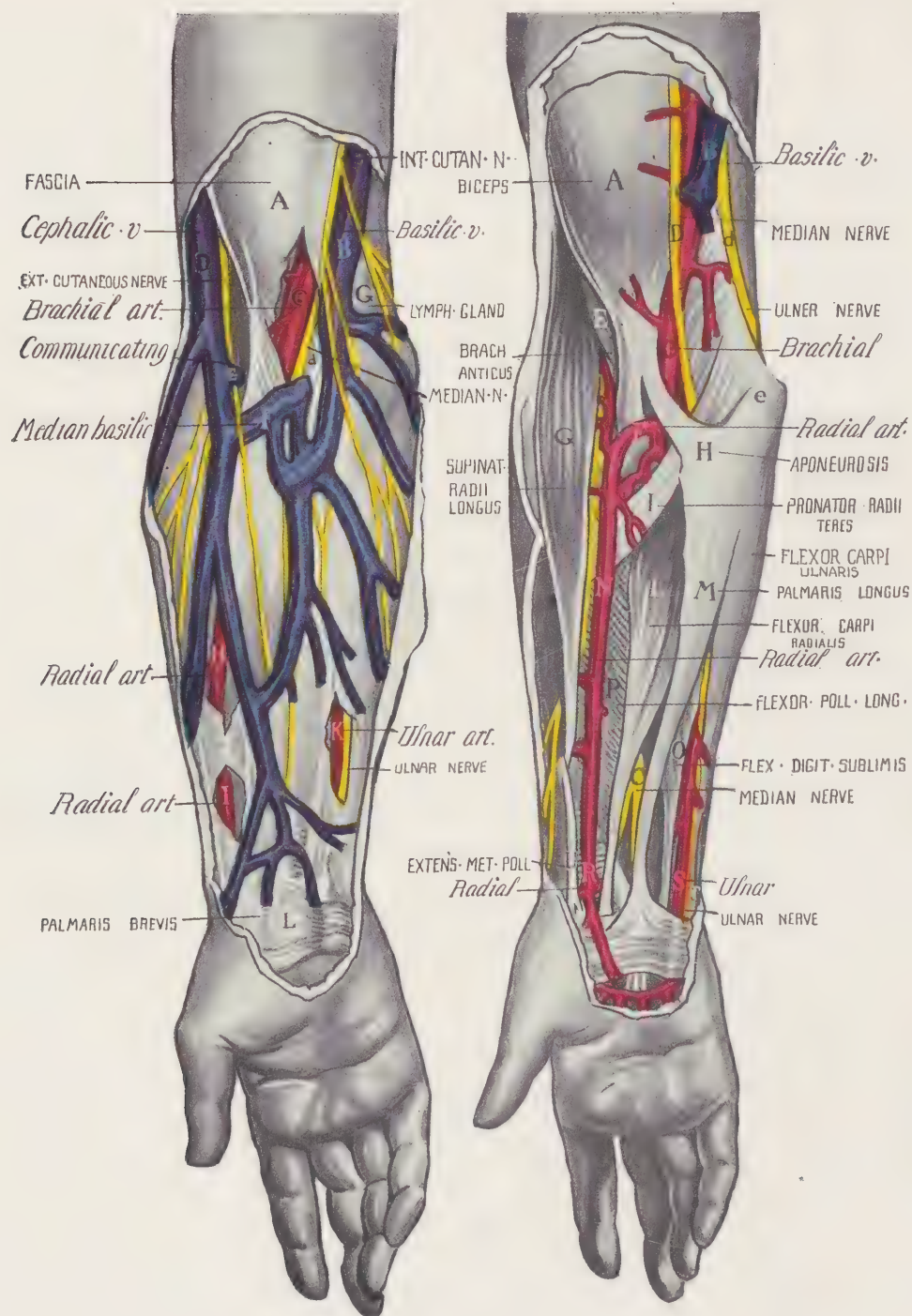
This practice on bodies enables them to acquire a skill sufficient to qualify them for the same work when they are called in regular practice after reaching home. To prepare a student to properly perform the many practical operations on bodies, in the largest morgue in the world, a theoretical course is given to each member of a limited class. After the courses of the various arteries and veins have been mastered, they are then required to do the practical work on bodies, provided for the purpose. This prepares them for their everyday work after leaving the school.

The arm is then dissected as per the illustration, so they will retain a mental picture of the course of the arteries and veins. When they are compelled to use the arteries and veins, this mental picture, as well as the training they have received, both theoretical as well as practical, places them in a position to do the work without any failures or even hesitation.

A glance at the colored chart will appeal to the reader as being clear enough to enable him to use it as a guide in locating and raising the artery and vein when using this as a point for injection. Sometimes the brachial artery divides in the upper part of the arm, but this is easily overcome by raising the artery nearer the arm pit. This bifurcation occurs only in a small percentage of the cases operated upon, so it will not give the embalmer much trouble.

It is well for the embalmer to hold the arm up so as to permit of the drainage of blood from the hand and forearm into the trunk of the body, before opening and injecting fluid into the brachial artery. It may be well to massage the finger nails, in case of discoloration, before injecting fluid into the body. We use a preparation that turns the blood a pink color, and this changes the nails to a natural pink, even when the discoloration is one of a number of days' duration. Always examine the lower part of the brachial artery before sewing up the incision, and if no fluid has escaped, inject the arm downwards, by all means, otherwise skin-slip may occur when drawing the arm through the clothing.

Plate No. 3. ARTERIES AND VEINS OF THE FOREARM



In some instances, when embalming is objected to on the ground of undue exposure of the remains, the radial artery (marked R), is used as a point for injection. We also show the ulnar artery (S), brachial artery (C), and beginning of basilic vein (B), which is formed by superficial branches of median basilic (F) vein.

Plate No. 3. ARTERIES AND VEINS OF THE FOREARM

When describing the radial artery in conjunction with the colored illustration, we may say this artery begins at a point just below the inner bend of the elbow, or where the brachial artery divides into the radial and ulnar arteries. It appears to be a continuation of the brachial artery, and is usually smaller than the ulnar artery. The brachial artery is shown on the colored illustration marked by the letter C, the radial artery by the letter N, and the ulnar artery by the letter S.

The illustration showing the superficial veins which unite to form the basilic vein marked B, and the cephalic vein marked D, also show portions of the radial and ulnar marked H and K respectively, while the lower portion of the brachial artery is marked C. This illustration will give the reader a very good idea of the position these blood vessels occupy.

These illustrations should be of great value to the embalmer in his work. The use of the radial artery as a point for injection is limited to a few embalmers, and even those who do use it limit themselves to its use as a last resort. This artery can be used in many instances where the remains have been dressed previous to the arrival of the embalmer, or in cases where objection is made to embalming on the ground of either excessive mutilation, or undue exposure of the remains, or in very old persons where there is little blood in the body, or where the presence of clothes makes the raising of another arterial branch impossible, unless the clothing is cut.

The colored illustration shows the course of the radial artery passing along the radial side of the forearm to the wrist after which it passes into the palm of the hand where it unites with the deep branch of the ulnar to form the palmar arch which sends branches to supply the fingers to their ends. This artery (radial) can be raised about three inches from the wrist, in order to conceal the incision when the clothes have been adjusted. The artery is easily found and is quite superficial throughout its entire course. It is covered by the integument, the superficial and deep fasciae, and in its lower third lies between the tendons of the flexor carpi radialis, marked L, and the supinator longus, marked G, and on top of the radius.

This artery can be used in any case, but its size, and the fact that the removal of blood must be carried on through a needle introduced into the right auricle of the heart, makes its use somewhat awkward. However, overlooking the above-mentioned objections, many embalmers use it in a large percentage of their cases. Its use is also

obligatory in cases where embalming may be objected to on the ground of exposure of the remains, especially in those cases where the funeral director is not provided with a lady assistant, and where the case in question is that of a female.

Many people are not acquainted with the technique of modern embalming, and their imagination is distorted by what others have told them, and what they may have seen, especially in those cases where embalmers have allowed vessels partially filled with blood and water, towels and bed clothing soiled with blood (probably due to the laceration or injury of arterial and venous branches by an untrained operator) to remain in the death chamber after their departure. This has done more to disgust and convey the wrong impression regarding modern embalming than anything else.

It probably is for these reasons that embalming is objected to, and in order to overcome these prejudices, it may be necessary for the embalmer to resort to the use of the radial artery as the point for injection. When this artery is employed, the incision may not be more than half an inch, as this is ample for the injection of fluid. The arterial tube is, naturally, smaller than that used for the injection of the brachial artery. The fluid should be injected slowly, otherwise a very rigid condition of the arm, if formaldehyde preparations are employed, will result, and the pressure exerted may impart a very unnatural appearance to the arm as well as the hand, should the fluid find its way downwards through the ulnar artery and then through the palmar arch. In modern embalming, where the newer preparations that do not harden the tissues and, which change the color of the blood from black to pink are used, this does not occur, and the fluid may be injected quickly, as its penetrating qualities are much greater than those of formaldehyde. In this respect, we may add that the added cost of these preparations acts as an impediment to their general use, but the results obtained by the use of these superior preparations, more than compensate for the additional expense of the preparation. The natural pink color of the tissues, and on the day of the funeral, the improved appearance of the remains, makes the use of these preparations imperative where good work and a natural appearance of the body is desired. The injection of the hand downwards is imperative, unless the fluid should find its way out of the opening made in the radial artery back of the point of injection; in which case the artery may be tied up at its lower end, and the operation continued in the usual manner. The removal of blood through the cardiac needle is then carried on, after each injection

of fluid into the artery, so as to equalize the filling of the arteries as the veins are relieved of whatever blood they may contain.

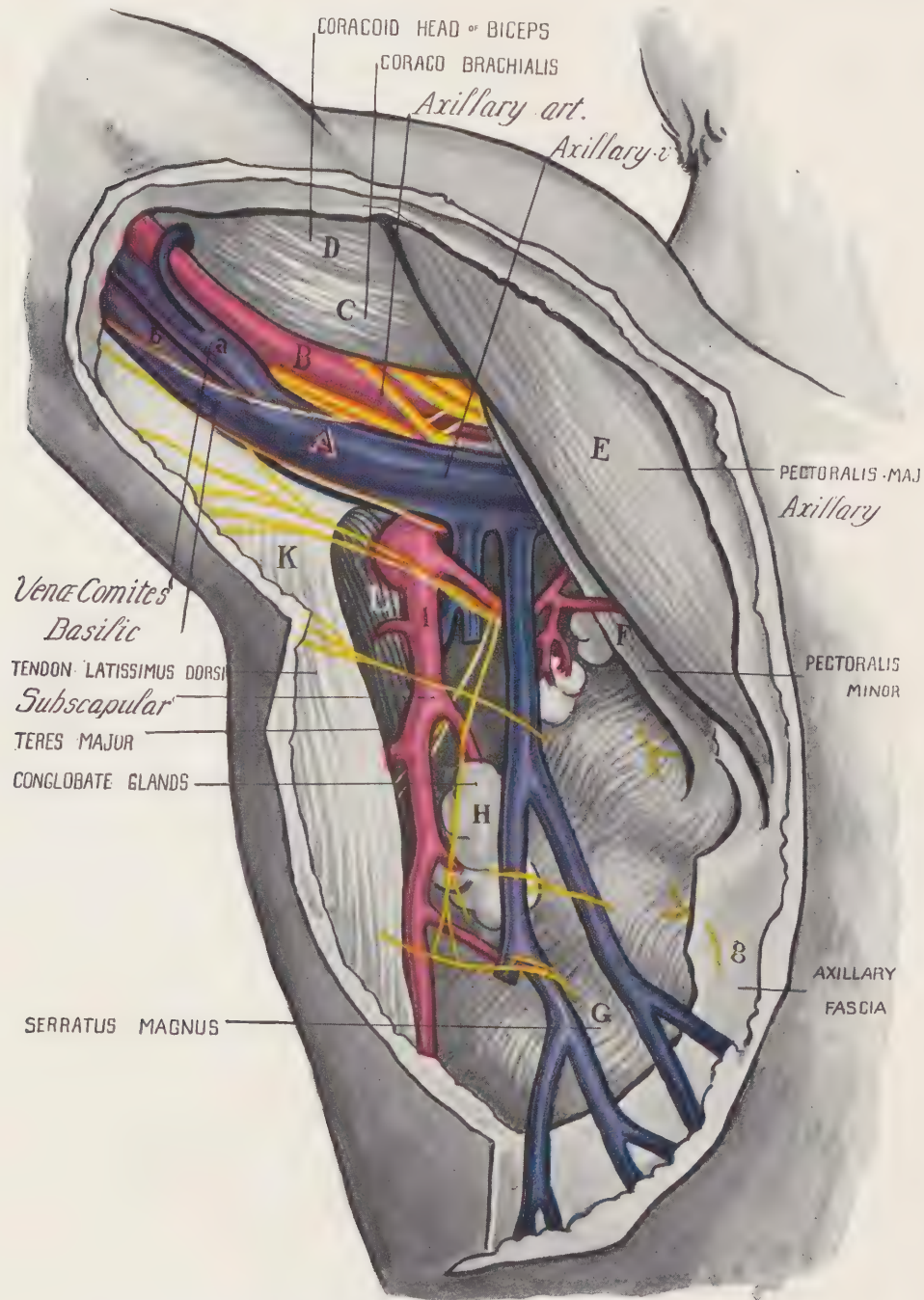
We may mention at this point another operation that can be performed through the radial artery. In a case of an old man, dead twenty-one days, the fingers were shriveled up at the ends and dried, their color being that of mahogany. The nails were black. Fluid that turns the blood pink and does not harden the tissues, was employed on this case by one of the students, and, in fifteen minutes the fingers were restored to a natural pink color, while the nails were as natural as in life.

The result of these tests enables us to make further research on the many bodies that are brought into the New York City morgue, the largest in the world, and our students are given the benefit of this vast amount of material for their special training. If we are able to do these wonderful things while training, it is only reasonable that we can also accomplish more wonderful things when the remains are dead only a few hours, for then we have everything in our favor. The radial artery is always demonstrated on bodies during the training and research work in the dissecting rooms, so its use can be easily carried out in such cases where it becomes imperative.

The use of the radial artery, therefore, is a very good one to keep in reserve so as to meet all the objections raised by those who may be ignorant of the true process of embalming and its requirements. If we were confined to the use of only one artery, we would indeed be in a bad predicament, but as modern training teaches the use of arteries located in all parts of the body, and we insist upon students being able to raise them, as well as to train them in the proper technique accompanying the use of each, there is no excuse for a trained student to be unable to care for any case.

It is a regrettable fact that only a small percentage of embalmers are really prepared to carry out the work of modern embalming, and such a large number stick to the old methods that have proven themselves inadequate. It is no wonder that so many complain of the embalming preparations on the market today. If you visit any undertaker's establishment you will find a large and varied selection of different brands of embalming fluid, and if asked why he has so many kinds on hand, he will say he has tried them and found them all wanting. If such is the case, there is either something wrong with the fluids or the embalmer, and I am of the opinion that it is the embalmer, and not the preparations that are made for his use.

Plate No. 4. AXILLARY ARTERY AND VEIN



The axillary space containing axillary artery (B), and axillary vein (A), in position. Also subscapular artery (I) and vein. The axillary artery is used by a large number of embalmers, because it is easy to raise; the arm pit usually containing very little fat, and being near the trunk of the body it affords easy passage of the improved blood tube through the basilic vein (A) into the right auricle of the heart. An excellent point for injection on account of the size of axillary artery (B).

Plate No. 4. AXILLARY ARTERY AND VEIN

The axillary artery and vein are now playing an important part in ordinary embalming operations. This artery has been selected, no doubt, on account of its position, and because it is larger than the brachial. In the colored supplement you will observe that the axillary marked B and the accompanying vein marked A, are both large vessels, and usually there is not as much fat as would be found under the same conditions in the arm proper. The axillary artery will be noted hugging closely to the inner border of the biceps, while that of the vein is near the triceps. The yellow colored markings indicate the various nerves in the arm. Those mostly encountered by the embalmer are the median, brachial, sub-cutaneous, ulnar and radial.

The colored plate shows the relative position of the large artery and vein. The artery is located on the upper and outer side, while the large vein is located on the lower or inner side. The arm pit is well adapted to embalming on account of the absence of an accumulation of fat, even in very fleshy bodies.

As both the artery and vein are large, and do not give off many branches, their use by the embalmer is considered excellent. These vessels are large and being located near the trunk of the body permit of easy passage of blood tubes into the larger veins contained in the trunk of the body. Much complaint has been made by embalmers when using the axillary artery and vein, due to the rapid return of fluid through the blood tube introduced into the vein. In most instances, the tube employed for the removal of blood only passes to the base of the neck on whichever side it is introduced. This only drains the veins of the head and neck, and as the pressure of fluid injected into the axillary artery is very much greater at this point than further away from the point of injection, it is only reasonable that fluid would pass through the collateral circulation existing between both of these vessels, and the rapid return of fluid is the result.

In cases where these blood tubes are employed, it seems to be that blood is removed from the side where the tube has been introduced, in larger quantities than from the opposite, so that unless the tubes are made to pass into the right auricle of the heart, or at least below the union of the two innominate veins blood is only drained from one side of the head and neck. If the blood tube is employed (and the latest improved

blood tubes pass into the heart direct), so as to remove blood from the venous system as it terminates in the right auricle of the heart, we are enabled to withdraw blood by draining both sides of the head directly through the external and internal jugular veins into the innominate veins, superior vena cava and into the right auricle of the heart.

If the body is on an incline, and the blood is in a sufficiently liquid condition to permit its gravitation to the lower parts from whence the blood is being aspirated, it is more likely to be successful than if the blood was being aspirated from one side of the head only. We may add at this point, when fluid is being injected into the axillary artery and blood is removed from the corresponding vein, if the blood tube has been passed into the right auricle of the heart, there will be no premature escape of fluid through the axillary vein. If fluid is injected into the axillary artery before any attempt has been made to remove blood, it will be noticed that the large external jugular vein will become distended, and if there is any discoloration present, it will not be dislodged until blood is removed from the blood tube, thereby indicating the rapid passage of fluid into the venous system through a short circuit or collateral circulation, principally through the capillary network existing between the artery and vein.

The practice of injecting fluid first, and removing blood afterwards, often leads to discolorations that cannot be removed, especially if the formaldehyde in the fluid is sufficient in percentage to quickly coagulate the blood. The use of the axillary artery is often attended by the distention of the various arterial branches and if the pressure is increased, as it often is when the operator is in a hurry to finish the work, the shoulder and neck become enlarged by the over injection of these parts due to the great pressure exerted at this point of injection. When these parts become enlarged as a result of this fast injection, they cannot be reduced again as the action of the fluid upon the tissues hardens them and prevents a reduction of the parts to their natural shape. This is what is often meant when the question is asked as to the swelling of the neck and shoulder while the body is being embalmed.

This condition can be overcome or, better still, prevented, by slowly injecting the fluid, at the same time having the body elevated in such a manner that the fluid will easily pass downwards through the trunk of the

body to the lower extremities. If this is always attended to, the fluid will not collect as easily in the shoulder and neck as it does when the injection is rapid and the elevation of the body is not as great as it should be.

In order to easily pass the improved blood tube into the right auricle of the heart, the arm should be held up at right angles with the body. This is done so as to raise the clavicle, thus making the passage of the tube under this bone easily accomplished. After the tube has passed beyond the clavicle, the point is then depressed so as to pass under the sternum, thereby permitting the tube to follow the natural course of the innominate vein into the superior vena cava, the right auricle of the heart. If the arm is held up as in the colored illustration, the passage of the tube will be impossible, in fact, the passage of any tube would be difficult under the same conditions.

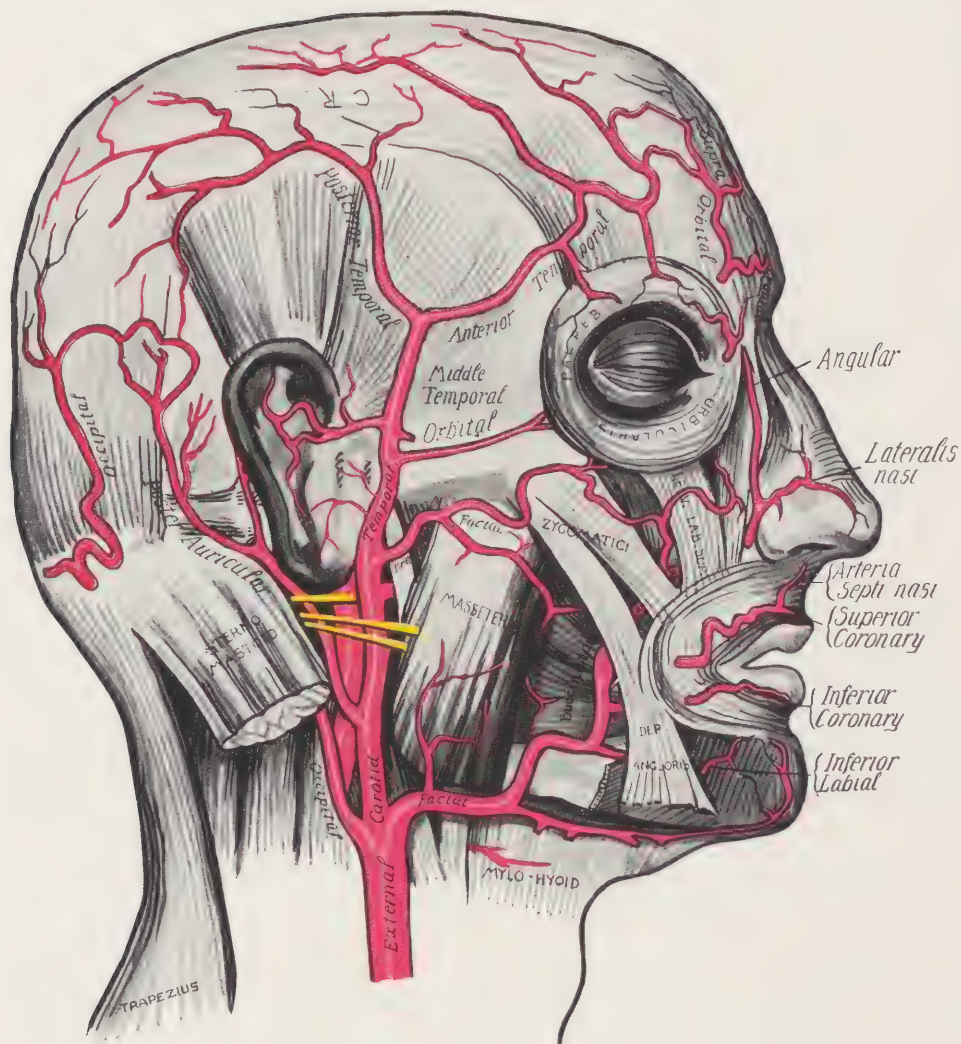
Of course, the anatomy of the arteries and veins must be thoroughly understood by the operator, for no tube is fool proof. If the course of the vein is clearly understood, the tube can be easily directed so as to follow the blood channel and thus easily pass into the right auricle of the heart. This operation is so simple, that the excuse for not passing a tube into the heart because it becomes caught at the collar bone, is ridiculous.

Too many men who claim they are embalmers, know too little about the anatomy of the human body. This seems to be the main reason for so many failures to perform the simple technique of ordinary embalming. If the colored plates are thoroughly studied, the reason for so many failures will be easily explained. The letters and names are a guide to those who desire to make a more profound study of the parts of the body that are necessary for the embalmer to use in his every day work.

The accompanying colored illustration of the arm pit should be of great value to those who use the axillary artery and vein as a point for injection. The nerves which are in yellow, have been drawn smaller than they really are in comparison with the size of the artery so as not to conceal it entirely. These nerves serve to confuse many embalmers who are not familiar with their presence, or who do not understand the true location of the axillary artery.

I have often seen embalmers try to inject fluid into the median nerve, and complain because the arteries were stopped up with some substance which rendered them impossible of injection.

Plate No. 5. ARTERIES SUPPLYING FACE AND SCALP



The illustration above gives the reader a clear idea of the many branches that supply the face and scalp. Those marked superior and inferior coronary show the manner in which the upper and lower lips are supplied with fluid to impart a dark ring around the mouth. This is especially so in cases of rapid injection. Those branches marked anterior and posterior temporal, become very prominent when the injection is too rapid. The internal carotid is shown under the external carotid artery.

Plate No. 5. ARTERIES SUPPLYING FACE AND SCALP

The arteries of the head, as featured here, are of the utmost importance to the modern embalmer. It will be observed that the common carotid artery divides into the external and internal carotids. The external carotids are the means of distributing preserving solutions to all parts of the face and scalp. The facial, occipital, posterior auricular, temporal, orbital, anterior and posterior temporal arteries are the main branches given off. It can be seen how these branches distribute fluid to all parts of the head.

It must be clear to the reader, especially if he or she has had experience in preserving the human dead, how the astringent properties of strong fluids tend to over irrigate certain parts of the face and head. If the injection is made by using considerable force, the astringent properties of the fluids constrict some of the smaller branches, thereby causing leathery patches to manifest themselves, while in other parts the fluid does not cause the same conditions due to the larger size of the branches. Thus, when the carotid arteries are used for injecting purposes, there will be observed a decided hardness on one side of the face, while the opposite side remains comparatively soft.

This has caused considerable discussion, but the true solution is clearly presented with the aid of the accompanying illustration. It is for this reason that a liberal dilution of the formaldehyde preparations has been advocated, as a "wash solution," and in many instances when this suggestion has been complied with, the preservation of the tissues has not been complete due to the weakness of the preserving solution. The suggestion of a wash solution is made for the purpose of permitting the fluid to pass through the smaller branches of the arteries and capillaries more thoroughly, for if the fluid containing a large percentage of formaldehyde is used, it does not penetrate as thoroughly as it should, thereby leaving certain parts of the face and scalp unprotected. Those parts of the face and scalp that do not receive their pro rata share of the preserving solution, undergo the same putrefactive changes that the entire body would, should no fluid be injected at all.

It is for this reason we have been compelled to make experiments with preserving solutions that do not contain formaldehyde, but are more energetic as antiseptics and disinfectants, and which do not alter the

natural color or velvety softness of the tissues. We are thus enabled to preserve the natural pink color of the tissues, thereby robbing the dead of that ghastly color so repugnant to the living, and at the same time doing away with the custom of painting the features with grease paints and various colored powders, which cause the body to resemble a performer on the stage.

If there is discoloration, the action of this preparation on the hemoglobin of the blood, causes it to become a pink color which reflects through the tissues, thereby imparting a pink color to the features.

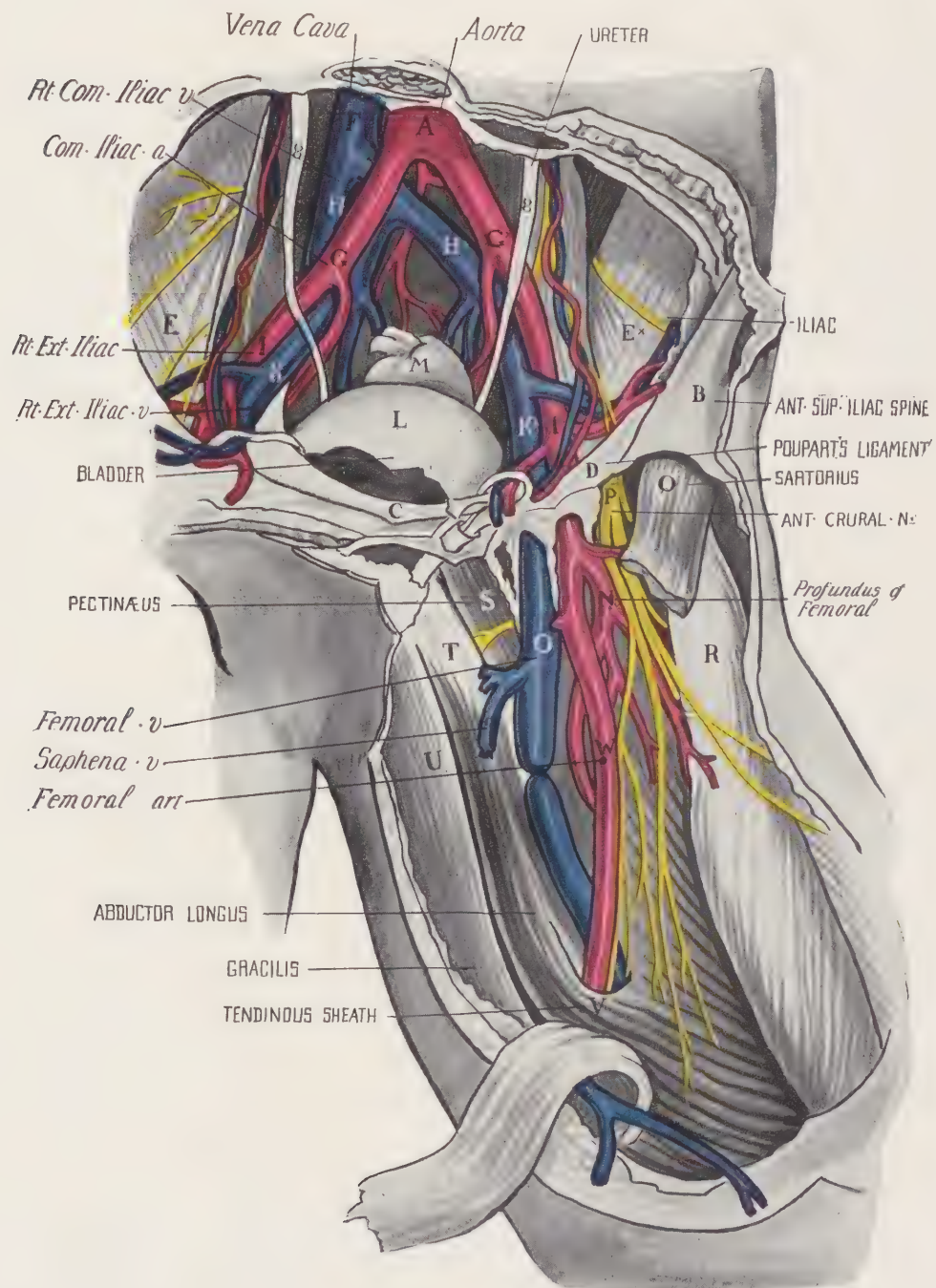
It may be well to mention, at this point, that we have been successful in combining chemicals with formaldehyde so as to prevent the coagulation of the blood. This is an important feature, as it permits the blood to be drawn from the body in larger quantities, thereby reducing discoloration. We are enabled to add firmness to the body without at the same time imparting that ashen, gray or putty color so prevalent when ordinary formaldehyde preparations are employed. The facial, coronary, nasal and angular arteries as seen on the colored supplement will give the embalmer a clear understanding how the pronounced gray, ashen or putty color is imparted to the lips, nose and forehead.

If we employ a non-formaldehyde preparation, especially one that imparts a pink hue to the tissues, the face presents a uniform lifelike color, and as this preparation is much stronger in its antiseptic and disinfecting properties, preservation of the tissues is assured, regardless of the fact that the body is not rendered as hard as cement. So many embalmers labor under the delusion that it is necessary to harden a body to keep it for a few days, when in fact we have bodies which have been injected for twenty years, and they are in a perfect state of preservation, and will remain so for hundreds of years longer.

All of the standard preparations will do the work if the embalmer only does his share. When failures are reported, the embalmer is at fault in many instances. Most failures are due to ignorance of anatomy, organic chemistry, and modern technique in embalming. So many embalmers follow the technique taught years ago, that they cannot appreciate the great difference between what they know and what they do not know.

Plate No. 6.

ARTERIES AND VEINS OF ABDOMEN AND THIGH



This illustration shows bifurcation of aorta (marked A), into iliac arteries and veins (marked H. J. G. I.), and femoral vein and artery (marked O. W.). An excellent point for injection in the bodies of males, when the arteries are empty of blood. The large femoral vein (marked O), offers an excellent point to remove the blood with the improved blood tube.

Plate No. 6.

ARTERIES AND VEINS OF ABDOMEN AND THIGH

The large arteries and veins contained in the lower region of the abdomen are of much importance to the embalmer. The accompanying plate shows the formation of the blood vessels used in embalming, when the femoral artery (W) is used as a point for injection, and the femoral vein (O) for the removal of blood.

The reader will observe that the formation of the arteries and veins is such that they can be easily used from one incision. The passage of the external iliac artery (I) and the external iliac vein (K) pass over the brim of the pelvis and under Poupart's ligament. It will be noted that these vessels lie close to each other. As they pass downwards the vein gradually passes under the artery and is bound to it by a sheath of tissue. As these vessels are large they offer a suitable point for injecting fluid and removing blood.

The aorta (A) is the end of the abdominal portion and dives into the two common iliac arteries (G) which give off the internal iliacs, which supply the organs contained in the pelvic cavity, while the external iliacs (I) pass into the thigh to form the femoral artery.

The femoral vein (O) receives the saphena in its upper portion, which acts as a means of drainage for the superficial veins of the lower extremity. The femoral artery (W) gives off the large profunda femoris (N).

It is through this branch that the return of fluid is accomplished after the lower extremities are supplied with fluid, especially if the lower portion of the femoral artery is not ligated before the injection is completed. This artery and vein may be located and raised by observing their passage downwards between the sartorius (Q) and the adductor longus (T).

These muscles form a depression between their inner borders, which acts as a guide to the location of these blood vessels. It is easily understood that if the body is elevated, the blood will rapidly gravitate to these parts of the body, thereby making its removal easy, especially with the improved blood tubes.

When this artery is used as a point for injection, care must be exercised to remove the blood from the lower portion of the aorta (A), otherwise the face may be flushed

as the result of forcing the blood into the upper portion of the arterial system.

The artery and vein are both large, thereby facilitating the use of the large tubes for both injecting fluid and aspirating blood. The ease with which these vessels may be located and raised, as well as the lack of contributing branches that may be broken by the operator, and the consequent escape of blood, makes its use most desirable.

For ethical reasons the use of these vessels is restricted to males, but lady embalmers are privileged to use them in their work on the opposite sex. The fact that bodies are always elevated on the board so that the head and shoulders are much higher than the femoral branches, permits the removal of blood from the arteries and veins of the head, neck and arms, thereby draining blood from those parts that are usually exposed. The drainage of blood from the upper parts permits the ready removal of discoloration should it be present at the time of embalming.

If the fluid is injected from the femoral artery, the fluid passes with equal force to each side of the body and head, and the preservation is more uniform than if the carotids were employed.

This equal distribution of fluid insures more uniform preservation, and prevents one side of the head from receiving more fluid than the other, thus overcoming the objections so often complained of, namely that one side was harder and better preserved than the other. This was fully explained when the arteries supplying the face and scalp were described.

It must be plain, after studying the various anatomical diagrams presented, that the use of the improved blood tubes makes the removal of blood from the femoral vein very easy to the trained operator. The reader must admit that the presentation of these plates makes the study of modern embalming easy, and shows how thoroughly the operation can be performed without extensive mutilation of the parts to be used by the operator.

The pressure employed in the injection of fluid is naturally greater than when using the brachial, axillary or carotid arteries, but as the injection is carried on from a point near the center of the body, this may be

overcome by employing the improved injecting pump, where the pressure may be maintained by merely depending upon the resistance of the handle of the pump. The rapid removal of blood from the upper portions of the venous system is accomplished through the inferior vena cava (F) through which the improved blood tube passes, and this permits the drainage to be carried on equally from both internal and external jugulars, as well as from the sub-clavian veins.

If the arms are elevated while the blood is being removed, this will insure the drainage of blood from both arms. If the finger nails are massaged while the blood is being aspirated with the improved pump, they can always be restored to their natural color, especially if the fluid employed does not coagulate the blood too rapidly.

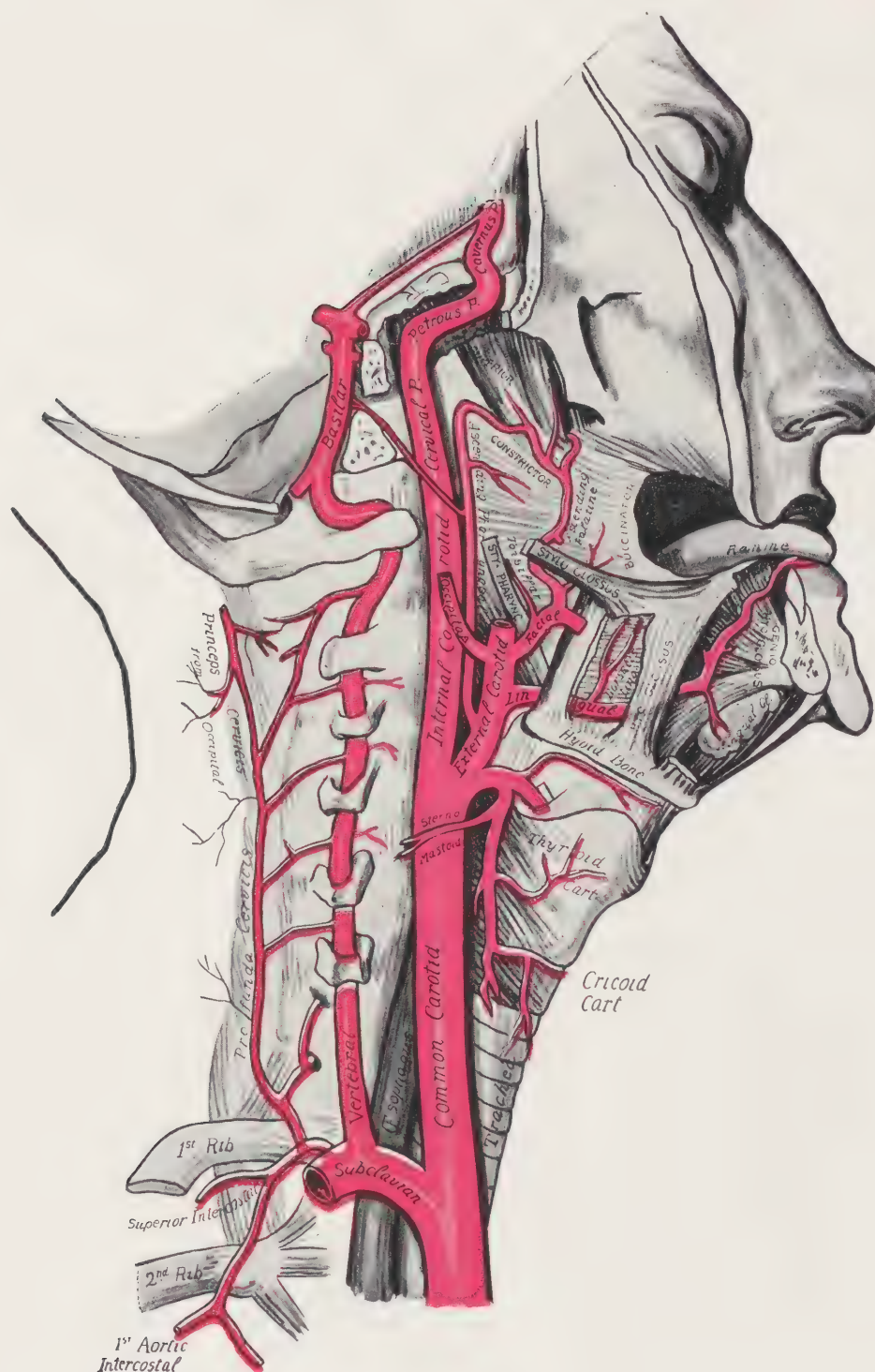
We are now able to restore discolored finger nails to their natural pink color, even after they have been discolored for a number of days. This is accomplished by the injection of preparations that act upon the iron in the blood and turn it from a leaden blue to a light pink color. We have even restored the dried ends of the fingers to their natural pink fullness, and this has been done repeatedly a number of days after death has taken place. The use of the femoral artery must appeal to the practical embalmer as being an excellent point for injecting fluid, and the femoral vein as an exceptional point from which to aspirate blood.

The main trouble with many embalmers is that they have not received the proper training in the technique of embalming, as well as their lack of anatomical knowledge. With both of these important branches thoroughly understood, embalming is easily accomplished, while failures are reduced to a minimum. Fluid will only pass where the operator directs it, and if the proper technique is lacking, there certainly will be failures of a greater or lesser extent.

The human body does not change in construction every day, so it is necessary for us to prepare ourselves so we can adapt our technique to the various conditions that present themselves in our daily practice, if we are to be successful in all cases.

Plate No. 7.

EXTERNAL, INTERNAL AND VERTEBRAL ARTERIES



This illustration shows the arterial branches through which the fluid passes to reach the interior of the head and face. The vertebral artery is seen branching from the subclavian and passing through the rings in the cervical vertebrae to contribute to the formation of the circle of Willis. The internal carotid can be traced to the point where it enters the cranial cavity to form the anterior portion of the circle of Willis. This circle plays an important part in the distribution of embalming fluid to the brain.

Plate No. 7.

EXTERNAL, INTERNAL AND VERTEBRAL ARTERIES

This plate shows the arteries that play such an important part in distributing the fluid to the internal and external parts of the head. It will be noted that the common carotid gives off no branches, but when it reaches a point on a level with the lower jaw, it branches into the internal and external carotids. It will be noticed that the external carotid has been cut off due to the dissection of the right side of the face and neck, although many small branches are still visible.

The internal carotid artery supplies the anterior part of the brain, the eye, and its appendages, and sends branches to the forehead and nose. Its size in the adult is equal to that of the external carotid, though in the child it is larger than that vessel. It is remarkable for the number of curvatures that it presents in various parts of its course. In its cervical portion it presents one or two flexures near the base of the skull, while through the rest of its course it describes a double curvature which greatly resembles the italic letter "S" placed horizontally. These curvatures most probably diminish the velocity of the current of blood, by increasing the extent of surface over which it passes and adding to the amount of impediment produced from friction.

The internal carotid commences at the bifurcation of the common carotid, opposite the upper border of the thyroid cartilage, and runs perpendicularly upward, in front of the transverse process of the three upper cervical vertebrae, to the carotid canal in the petrous portion of the temporal bone. It is superficial at its commencement, being contained in the superior carotid triangle, and lying on the same level as the external carotid, but behind that artery overlapped by the sterno-mastoid and covered by the deep fascia. It will be noticed by tracing the internal carotid on the colored supplement that the cervical, petrous and cavernous portions are marked for the benefit of the reader. The cerebral portion having perforated the dura mater on the inner side of the anterior clinoid process, the internal carotid enters the inner extremity of the fissure of Sylvius, where it gives off its terminal or cerebral branches. The vertebral artery is generally the first and largest branch of the subclavian, it arises from the upper and back part of the first section of the subclavian, and, passing upward, enters the foramen in the transverse process of the sixth cervical vertebra, and ascends through the foramina in the transverse process of all the vertebrae above this.

Above the upper border of the axis it inclines outward and upward to the foramen in the transverse process of the atlas, through which it passes, it then makes a sharp turn backwards and pierces the dura mater and enters the skull through the foramen magnum. It then passes forward and upward to the front of the medulla oblongata, and unites with the vessel of the opposite side at the lower border of the pons varolii to form the basilar artery. The union of the vertebral arteries at the back and base of the cranium is plainly seen, and the formation of the basilar artery can be traced from

this point where it communicates by means of branches with the internal carotids in the front to form the circle of Willis.

It is thus plain to follow the course of the fluid when injected into any of the arteries used by embalmers, and to see at a glance how the brain and other portions are preserved if all of the branches pictured in this colored plate are filled to their capacity.

A study of the formation of the internal carotid and vertebral arteries to form the circle of Willis, will show how the circulation is interfered with when the brain is removed for the purpose of examination. It will be observed that the vertebral and carotids are severed near their entrance into the cranial cavity, thus permitting the escape of fluid from these severed ends. To remedy this it will be necessary to ligate or tie these ends. This is accomplished in all cases where the skull cap has been restored and the scalp sewed together, by re-opening these parts. Sometimes the branches have been severed so close to the bony floor of the cranium that their ligation is impossible, especially the internal carotids. If such is the case, the cavernous portion of the internal carotid can be dissected from its bony canal so as to permit of its ligation below the point where the artery was severed. By consulting the colored supplement the cavernous portion of the internal carotid can be easily seen forming a double curve. As to the vertebral arteries, there is always enough of these vessels remaining to permit of their ends being tied with thread. This can be facilitated by using the arterial forceps so as to hold the cut ends up in position. If the ends of both the internal carotids and vertebrals have been cut too short for ligation, the floor of the skull can be coated with liquid cement mixed with wood alcohol or alcoholic fluid, when coagulation and hardening of this preparation will soon take place, thereby sealing up all severed ends of arteries leading into the cranial cavity.

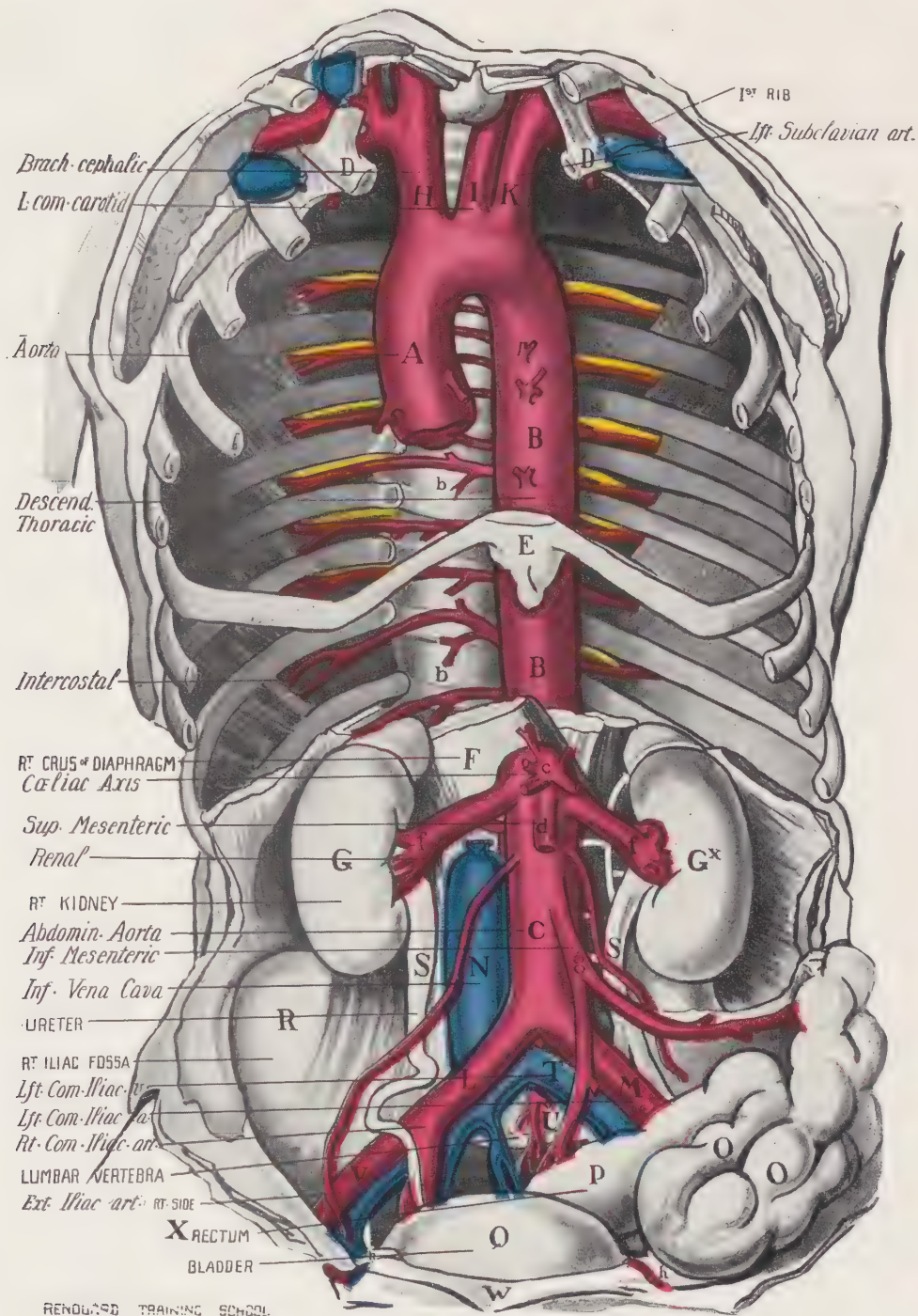
This would have to be attended to before fluid is injected into the arteries, otherwise leakage would result. If the operator is unable to find the severed ends of the arteries, the injection of a small amount of fluid and its consequent escape from the severed ends will quickly indicate their location. The skull cap is then returned to its original position, the scalp is then sewed in place, and the injection continued as if nothing had been done in the way of removing the brain. When the internal carotids and vertebrals have been ligated or sealed up, the fluid would naturally pass through the external carotids, posterior auricular and occipital arteries to supply the posterior portions of the scalp as well as the anterior and facial branches. There would necessarily be some leakage, but the action of the fluid upon those small branches which supply the scalp, would shrink them up so that the escape of fluid would be limited and of short duration. It is very necessary that care should be exercised in noting that the arterial branches of the outside of the head as well as those of the inner portion, receive their usual share of fluid, otherwise those portions that do not receive fluid would quickly show signs of putrefaction.

When death is caused by a gun shot wound through the temple, the circle of Willis is seldom interfered with, but there are many small branches that supply the brain that will be ruptured, but the temporary escape of fluid, mixed with blood, from the hole made by the passage of the bullet can be easily checked by the passage of cotton into the same opening. The cotton, if forced into the bullet hole, will fill up the cavity caused by the passage of the bullet through the brain, and the cotton tampon pressing upon the brain-matter will check the hemorrhage of blood and fluid. It will also be noted by the colored supplement that even if the vertebral or internal carotids are obstructed by the presence of coagulated blood, the fluid will always pass into the branches that are empty. In this manner the fluid will always be sure of distribution into the brain if the injection of the arteries is carried out in keeping with well defined rules of modern embalming. Too much cannot be said of the thorough injection of the arteries in all cases, and especially of those which supply the head internally as well as externally. If no fluid passes into the internal portions of the head, gas will generate, forcing the eye balls out of the sockets. This condition will throw the eye lids apart, giving the case a very unnatural expression, as well as cause the parts to become distended under this gaseous pressure. The passage of gas through the optic opening will give the tissues, surrounding the eye ball, a puffy appearance. It is these conditions that always indicate a lack of fluid into the internal parts of the cranium, and not the lack of antiseptic properties of the solution employed.

It is a well known fact that the brain putrefies with alarming rapidity, hence the necessity of irrigating this portion of the human anatomy with a liberal supply of fluid. It may be said that formaldehyde fluids harden the parts so as to permit the operator to judge of its passage, but the internal portions of the head cannot be felt for this hardening process to demonstrate the passage of fluid. If we use the weight of the body as a guide, modern embalming technique does not require the fluid to harden the parts through which it is passing, to enable us to judge of the amount necessary to reach all parts. The weight of the body tells us the amount of preserving solution necessary to fill these arterial branches as completely with embalming fluid as they were with blood during life.

If this rule is followed, it will not be necessary for the modern operator to pinch the various parts of the body to ascertain if they are becoming hard or otherwise. It is a well known fact, proven by daily research experiments in the laboratory, that a scientific training is of the utmost importance in modern embalming. This fact is being impressed upon the minds of those who are now engaged in this profession, but who experience many failures due, not to the lack of preserving properties of the fluids employed, but to their own lack of technical training in modern embalming.

Plate No. 8. AORTA AND ITS MAIN BRANCHES IN TRUNK OF BODY



This anatomical plate gives the reader a concise idea of the aorta and the branches that supply the thoracic and abdominal viscera. The aorta (marked A. B. C.) represents the ascending, descending and abdominal sections of this large artery. The arch of the aorta gives off three branches (marked H. I. K.) representing the innominate, left common carotid and left sub-clavian arteries. The right and left common iliac arteries are marked L. and M.) seen passing down below the bifurcation of the abdominal aorta. The aorta is the main arterial branch in the trunk of the body, and distributes the embalming fluid to the various organs and glands, during the process of embalming. It is very necessary that the embalmer should become familiar with these branches when injecting a body after an autopsy has been performed.

Plate No. 8. AORTA AND ITS MAIN BRANCHES IN TRUNK OF BODY

This plate illustrates in colors the largest artery in the human body, namely the aorta (marked ABC). The ascending portion of the aorta (marked A) is about two inches in length and later forms the arch of this great artery which gives off three branches. The first of these branches is the innominate (marked H) which divides into the right common carotid and right sub-clavian arteries. The second branch (marked I) is the left common carotid and the third branch (marked K) is the left sub-clavian artery. These branches supply the head and arms together with many branches which the sub-clavians give off that supply the muscles of the neck and shoulders. The next section of the aorta (marked B) is known as the thoracic aorta. While the aorta is in the chest it supplies the substance of the lungs by means of the bronchial arteries and the outside of the heart is supplied with the coronary arteries. The many lateral branches passing between the ribs are the intercostal arteries, eleven on each side. These supply the muscles of the back, spaces between the ribs and walls of the chest in front.

The third section of the aorta is the abdominal (marked C). The first branch given off by the abdominal aorta is the stomach. The hepatic artery supplies the coeliac axis (marked C). This branch is about one inch long and divides into three branches called the gastric, hepatic and splenic arteries. The gastric artery supplies the upper border of the liver and gall bladder, while the splenic artery supplies the pancreas, spleen and lower curve of the stomach. Immediately below this the abdominal aorta gives off a larger branch named the superior mesenteric (marked d) which supplies the walls of the large intestines on the right side. The aorta then gives off two lateral branches named renal arteries (marked f) which supply the kidneys.

About two inches below this point the aorta gives off the inferior mesenteric artery (marked g) which supplies the large and small intestines on the left side. The abdominal aorta then passes down until it reaches the fourth lumbar vertebra or a little to the left of the umbilicus where it divides into the two common iliac arteries (marked L M).

The common iliac arteries are usually about two inches in length; they pass downward and outward to the margin of the pelvis and divide between the last lumbar vertebra and the sacrum into two branches named the external and internal iliac arteries, the external supplying the lower extremity, and the internal the viscera or organs of generation, rectum and urinary bladder, as well as the walls of the pelvis.

The right common iliac artery is somewhat larger than the left. The right external iliac artery is marked V on the colored supplement. This illustration gives the reader a concise idea of the branches used by nature in the distribution of blood to the viscera of the chest and abdomen during life, and the conveyance of embalming fluid after death.

A study of the many branches given off by the aorta will enable the embalmer to care for any case where the organs or glands have been removed for medico-legal exam-

ination or after an autopsy has been held by the coroner or his medical assistant.

There are many instances where it becomes necessary to remove some or all of the organs and glands contained in the trunk of the body, and when this is done, it necessarily means the severing of nearly all of the large branches given off by the aorta. This means additional work for the embalmer, and if he is not conversant with the branches destroyed, he will not be able to properly inject the various parts of the body to which the remaining branches convey the fluid. If the heart, stomach, kidneys, liver or lungs have been removed and the trunk of the body sewed with thread, it will necessitate the reopening of the body to locate the extent of the mutilation of the branches. If the embalmer is not acquainted with the various branches given off by the aorta, his work will be far from satisfactory, as he will not be able to inject the body from the points of injury. This is a simple operation if the embalmer has been trained in anatomy.

The process of embalming after an autopsy, as carried out by so many so-called embalmers, is to raise any of the arteries used in ordinary embalming and inject fluid into them. Of course, the fluid will naturally run out of the severed branch in the interior of the body, and the conclusion usually reached as a result of the leakage is, "that the body is too much cut up to do anything with it."

The work is stopped at this point, as far as the injection of the arteries are concerned, and some fluid is then injected into the cavity by means of the embalming needle, passed between the stitches. This is a very crude way to treat a case of this character, but when we consider the small sum charged for embalming, is it any wonder that more time and study are not devoted to the preparation of this class of cases? I believe every embalmer should be paid for his work according to the amount of labor expended in any case, and when it requires additional work to properly prepare a case where an accident has caused mutilation, or an autopsy has been performed, the embalmer should be paid extra for this class of work.

We may say the same of dropsy, blood poisoning, septic peritonitis, puerperal fever or drowning. It will be seen by observing the colored supplement that if the stomach has been removed the gastric and possibly the splenic arteries will be severed, and in this case the arteries can be injected from the point of injury, by merely reopening the body where the stomach or liver was removed.

If an autopsy has been held (and by the way, all embalmers should be well enough trained to do this sort of work, for it is absolutely necessary to hold post mortem examinations in many cases of suspected poisoning, or to detect crime, as is so often recorded in the daily press), it will necessitate the severing of the innominate, left common carotid, left sub-clavian and common iliac arteries. The removal of the viscera will be necessary of course, and is afterwards returned to the trunk of the body which is then sewed up with thread.

If it is intended to prepare the body so as to keep it for some days or to ship it

to some distant point, it will be necessary to prepare the remains as thoroughly as it would be had no examination been held on the case in question. To accomplish the thorough preservation of the body for transportation or otherwise, the head, neck, shoulders, arms and lower extremities will have to be preserved, as well as the lower portion of the trunk of the body. It will first be necessary to remove the viscera and place it in a solution of crisin or any other preparation that will instantly preserve and dry it up, and allow it to remain in this solution while the severed branches of the arterial system are being injected.

After the arterial branches have been injected, and the accompanying veins have been tied, should the return of fluid and blood necessitate this procedure, the inner surface of the trunk of the body should be washed with some preparation that will act quickly and thoroughly, so as to reach all parts of the walls of the chest and abdomen, as well as the lips of the incision made when the body was opened. The viscera can then be restored to the trunk of the body after which it is again sewed up. Or, if the embalmer is present at the time the autopsy is performed, he may assume charge as soon as the operation is at an end, and thus save time in the preparation of the body.

As the intercostal and lumbar arteries have been severed, it will be necessary to inject the walls of the chest and abdomen with the new curved cutaneous needle to distribute fluid to the parts that the above mentioned arteries supplied before they were severed by the medical examiner. This should be done after the body has been sewed up, for it is much easier to pass the needle through the walls between the stitches than before the sewing has been done.

Much care must be exercised when the carotids are being injected to see that a like amount of fluid is used in each one, otherwise the face will present a variation in color as well as firmness, one side being harder than the opposite, as well as being different in color.

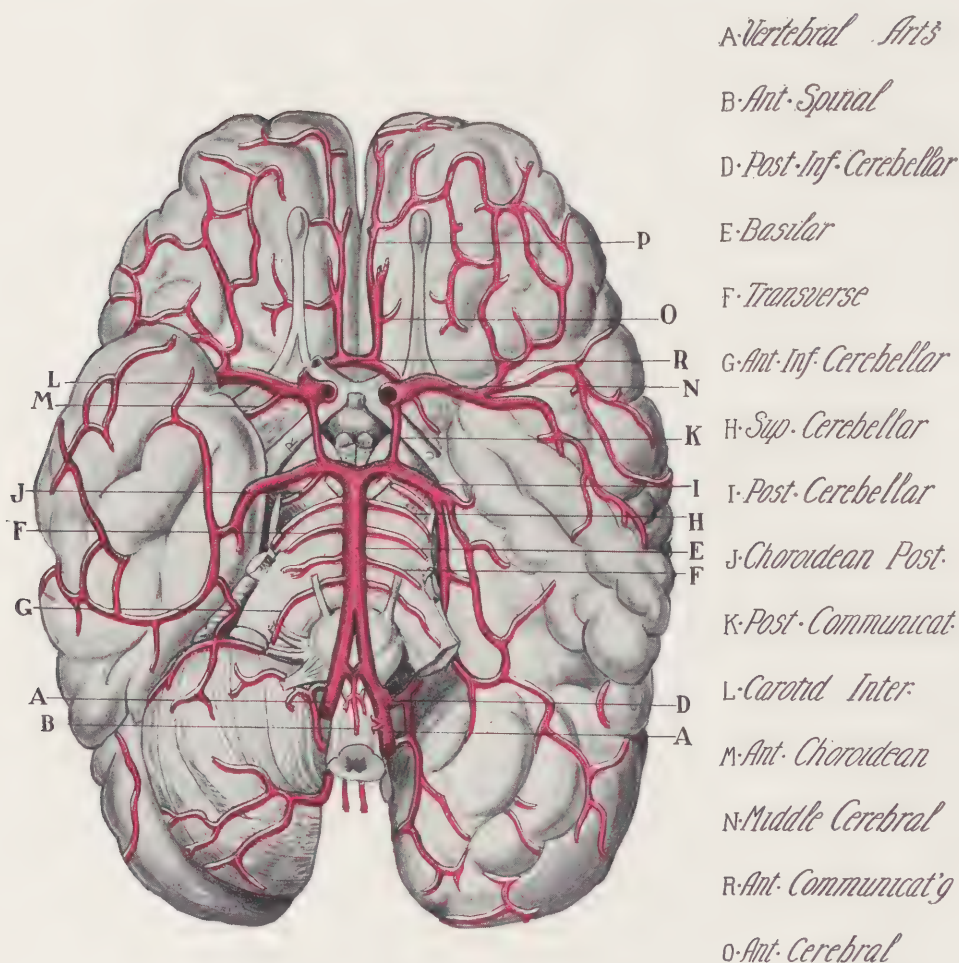
Of course, with the newer preparations that turn the blood pink and do not harden the tissues or impart a gray color, it is not necessary to be as careful, but when formaldehyde is the base of the preparation employed, especial care is necessary to insure uniformity.

The proper treatment of mutilated cases should be thoroughly understood by all embalmers. The proper preservation of all cases where an accident has caused extensive mutilation, or the knife of the medical examiner has severed the large branches that we depend upon for the distribution of our preserving solutions, can be readily studied by consulting the colored plates.

A study of the arteries of the body is a valuable part of our training. Too much stress cannot be placed upon the necessity for a thorough training in all the branches of this profession, so that we may be prepared to care for any case, regardless of the cause of death.

We are now able to perform operations and produce results in the most difficult cases that are amazing to the untrained embalmer.

Plate No. 9. ARTERIES SITUATED AT BASE OF BRAIN



This anatomical illustration gives an exact reproduction of the arteries located at the base of the brain. The internal carotids are marked (L) and show where they have been severed to permit of removal of the brain. The two vertebral arteries (marked A) are seen passing on either side of the medulla oblongata which is the termination of the spinal cord in the brain. These vertebral arteries form an anastomosis known as the circle of Willis. It is formed in front by the anterior cerebral arteries (marked O) which are branches of the internal carotids, which are connected by means of the anterior communicating (marked R). In the back by the two posterior cerebral, (marked I), branches of the basilar (marked E) which are connected on both sides with the internal carotids (marked L) by the posterior communicating arteries (marked K). The four arterial branches that supply the brain with blood are the two vertebral arteries (marked A) and the two internal carotids (marked L). These branches play an important part when the arteries are injected after removal of the brain.

Plate No. 9. ARTERIES SITUATED AT BASE OF BRAIN

This plate clearly shows the arterial branches that supply embalming solutions to the various lobes of the brain. The four large branches that contribute to the conveyance of blood during life and embalming solutions after death are the two internal carotids (marked L), and the two vertebrals (marked A). It will be observed that these branches are cut at a point that permits the removal of the brain from the cranium. We may describe the vertebral arteries from their source so as to give the reader a more intelligent idea of their course from the time they branch from the sub-clavian to the point where they have been severed as illustrated in the colored plate.

The vertebral artery is generally the first and largest branch of the sub-clavian. It arises from the upper and back part of the first section of the sub-clavian, and, passing upward, enters the opening in the transverse process of the sixth cervical vertebra at the base of the neck and ascends through the opening in the vertebrae above this until it reaches the atlas where it makes an abrupt turn backwards where it pierces the dura mater and enters the skull through the foramen magnum (occipital opening). It then passes forward and upward to the front of the medulla oblongata (the enlarged portion of the spinal cord in the cranium), and unites with the vessel of the same name at the opposite side at the lower border of the pons varolii (the white bulb-like eminence situated above the medulla oblongata and which serves to connect the various divisions with one another, and which can be seen just below the basilar artery marked E), to form the basilar artery.

The basilar artery, so named from its position at the base of the skull, is a single trunk formed by the junction of the two vertebral arteries (marked A); it extends from the posterior to the interior border of the pons varolii, lying in its middle groove under cover of the brain covering (arachnoid). It ends by dividing into two branches, the posterior cerebral arteries (marked I).

The posterior cerebral arteries (marked I), the two terminal branches of the basilar, are larger than the preceding, from which they are separated near their origin by the third nerves, which are not lettered on the colored supplement. Winding, they pass under the occipital lobes of the cerebrum and divide into three main branches. Near their origin they receive the posterior communicating arteries (marked K) from the internal carotids.

The posterior communicating artery (marked K) arises from the back part of

the internal carotid (marked L), runs directly backwards and communicates with the posterior cerebral (marked I), a branch of the basilar. This artery varies considerably in size, being sometimes small, and occasionally so large that the posterior cerebral may be considered as arising from the internal carotid rather than from the basilar. It is often larger on one side than on the other. The middle cerebral artery (marked N) the largest branch of the internal carotid, passes obliquely outward and divides into a number of branches, as can be plainly seen on the colored plate.

The anterior cerebral artery (marked O) arises from the internal carotid. It passes forward in the great longitudinal fissure between the two anterior lobes of the brain, being connected, soon after its origin, with the vessel of the opposite side by a short connecting trunk, about one-eighth of an inch in length, known as the anterior communicating (marked R). The two anterior cerebral arteries, lying side by side, curve around the anterior border of the corpus callosum (the hard substance uniting the cerebral hemispheres and lies between the two anterior cerebral arteries marked O), and run along its upper surface to its posterior part, where they terminate by communicating with the posterior cerebral arteries. All of the above arteries contribute to the formation of the circle of Willis. The cerebral arteries are derived from the internal carotids and vertebral arteries which by uniting at the base of the brain form the above mentioned circle.

The circle of Willis is formed by the anterior cerebral arteries branches of the internal carotids (marked L), which are connected by the anterior communicating cerebral artery; behind by the two posterior cerebral (marked I), branches of the basilar which are connected on each side with the internal carotids by means of the posterior communicating cerebral arteries (marked K).

The above description of the various arterial branches that supply the brain with embalming fluid when the arteries are properly injected, will prove to the reader the necessity for thorough injection. When any portion of the brain is deprived of its pro rata share of preserving solution, putrefactive changes manifest themselves with alarming rapidity for the brain decomposes very quickly together with the eye and mucous membrane that lines the wind pipe.

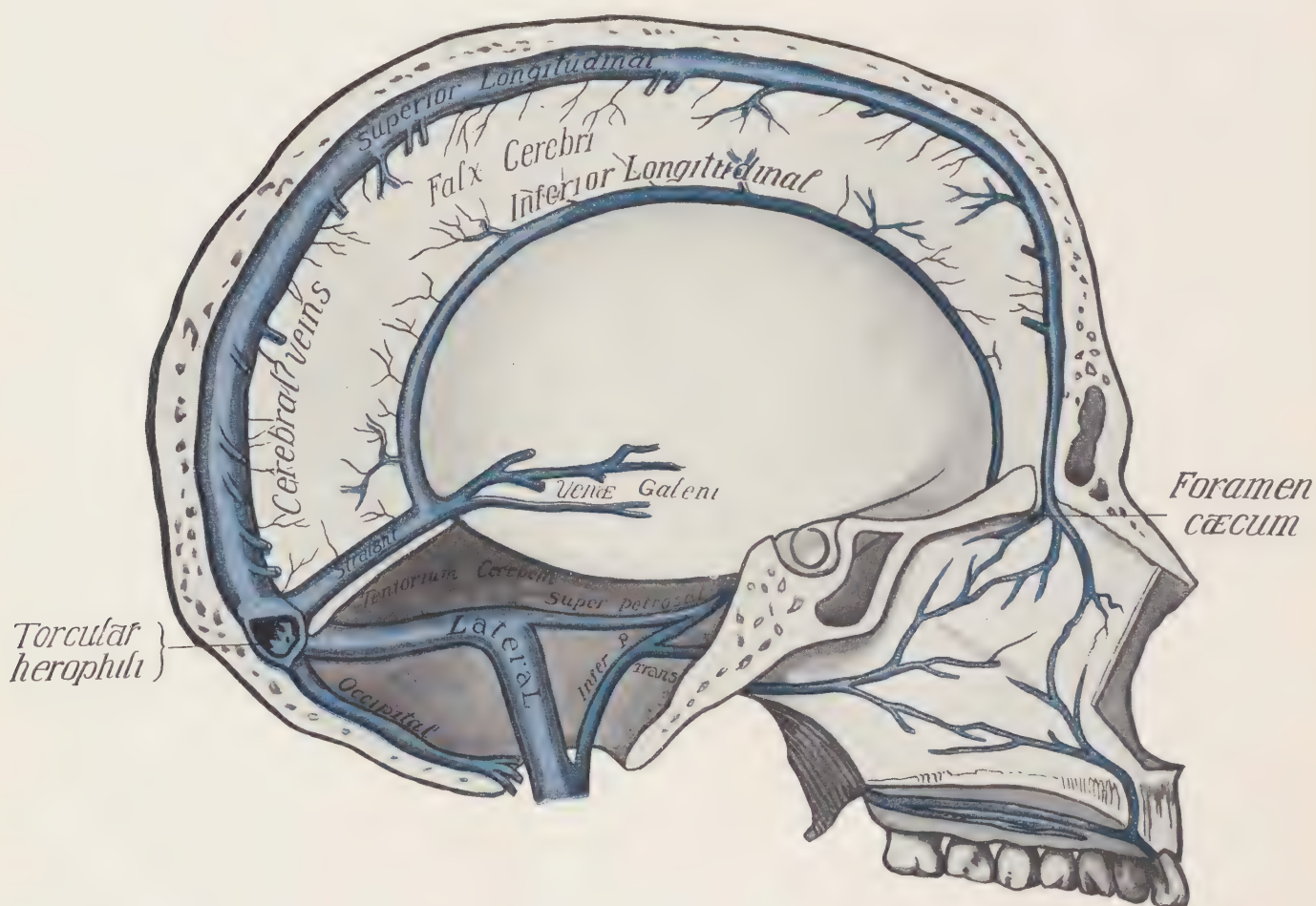
When the brain is not properly injected through the various arterial branches not receiving their share of fluid, putrefactive changes generating gas in the cranial cavity cause the eyes to bulge out, thereby holding the eyelids apart. The formation of gas due to the putrefactive changes taking place in the brain substance will also press upon the sinuses of the membranes covering the brain thereby contributing to discoloration of the head as well as preventing the removal of blood from these venous branches. When these conditions are not corrected, gas formed in the cellular tissue will cause the head to become much swollen and discolored, such as is observed in the case of those who have been in the water in hot weather. It is therefore very necessary for a number of days during the hot weather when the arteries are being injected to bear in mind that the brain, which decays very quickly after death, should receive its full share of preserving fluids. The passage of the fluid through these arterial branches will facilitate the removal of blood from the cerebral sinuses.

This portion of the body requires as much attention as the remainder of the body, and if the arteries are to be injected with an amount of fluid after death corresponding to the amount of blood required to fill them during life, the weight of the body plays an important part in estimating the proper amount of fluid necessary to fill the arterial system completely.

The fact that science has enabled us to compound preserving preparations that do not constrict the smallest vessels and that do not harden the tissues, permits of a thorough passage of the fluid through the smallest and most delicate vessels we must employ to convey the fluid to all parts. As this preparation does not coagulate the blood it simply washes the blood out of these vessels thereby preventing the blood from remaining in the sinuses and causing putrefactive changes to manifest themselves. If there is discoloration, this preparation by causing the blood to change to a light pink color, thereby adds the most natural color to the tissues. As this preparation is already for use, without diluting it with water, it will properly care for all cases regardless of the cause of death, or the condition of the body at the time of death. When diluted with equal parts of water and used hypodermically, it will bleach black discolorations to a natural pink color without altering the delicate texture of the finest skin. It will also restore a green spot to its natural color without leaving any evidence of its presence.

Plate No. 10.

VERTICAL SECTION OF SKULL SHOWING ITS SINUSES



This colored illustration shows the venous branches printed in blue to illustrate the venous blood they contain. The sinuses of the dura mater are venous channels having a resemblance to the veins, their outer coat is formed by the dura mater which is the outer covering of the brain, and their inner coat by a continuation of the lining membrane of the veins. The superior longitudinal sinus which has name attached and is printed in blue ink is seen attached to the margin of the falx which is in the form of a sickle. This sinus will be seen running backward from the foramen caecum to the torcular herophili, where it terminates. The torcular herophili is the dilated extremity of the superior longitudinal sinus which is plainly marked on the illustration. From the torcular herophili we enter the lateral sinuses, which are of larger size, as is plainly seen in the illustration. They pass outward to the base of the petrous portion of the temporal bone where it will be observed, they curve downward and inward on each side to reach the jugular foramen, where they terminate in the internal jugular vein, at which point the colored section in the illustration ends. These sinuses play an important part in the removal of blood from the interior of the head when discoloration is present.

Plate No. 10.

VERTICAL SECTION OF SKULL SHOWING ITS SINUSES

This plate gives the reader a clear idea of the blood vessels situated on the inner side of the skull. These blood vessels play a very important part when discoloration of the head and neck is present. In order to appreciate the importance of these vessels in the removal of blood from the head, it will be necessary to describe the various branches as they terminate in the large sinuses shown in the colored supplement.

The cerebral veins are remarkable for the extreme thinness of their coats in consequence of the muscular tissue in them being wanting, and the absence of valves. They are divided into two sets; the superficial, which occupy a position on the surface, and the deep veins, which occupy the interior of the organ. The superficial cerebral veins ramify upon the surface of the brain, being lodged between the convolutions, a few running across the convolutions. They receive branches from the substance of the brain and terminate in the sinuses as shown on the colored supplement. They are named from the positions they occupy, superior, median and inferior cerebral veins. The superior cerebral veins, about twelve in number on each side, return the blood from the convolutions on the superior surface of the hemisphere; they pass forward and inward toward the great longitudinal fissure, where they receive the median cerebral veins; near their termination they become invested with a tubular sheath of the arachnoid membrane, and open into the superior longitudinal sinus in the opposite direction to the course of the blood. The median cerebral veins return the blood from the surface of the corresponding hemisphere; and open into the superior cerebral veins, or occasionally into the inferior longitudinal sinus.

The inferior cerebral veins ramify on the lower part of the outer and on the under surface of the cerebral hemisphere. Some, collecting tributaries from the under surface of the anterior surface of the brain, terminate in the cavernous sinus. One vein of large size, the middle cerebral vein, commences on the under surface of the temporal sphenoidal lobe, and terminates in the cavernous sinus. Others commence on the under surface of the base of the brain, and unite to form from three to five veins, which open into the superior petrosal and lateral sinuses from before backward.

The sinuses of the dura mater are venous channels having a resemblance to the veins, their outer coat is formed by the dura mater, which is the outer covering of the brain, and their inner coat by a continuation of the lining membrane of the veins. The superior longitudinal sinus is attached to the margin of the falx which is in the form of a sickle.

Commencing at the foramen caecum, through which it constantly communicates by a small branch with the veins of the nasal fossae, it runs from before backwards, grooving the inner surface of the frontal, the adjacent margins of the two parietal, and the superior divisions of the crucial ridge of the occipital bone, and terminates by opening into the torcular Herophili. If you will carefully study the superior longitudinal sinus, you will observe that there are many small branches terminating in

it, as we have before described when tracing the course of the cerebral veins. The sinus is triangular in form, narrow in front, and gradually increasing in size as it passes backward. On examining its inner surface it presents the internal openings of the superior cerebral veins, which run, for the most part, from behind forward, and open chiefly at the back part of the sinus, their orifices being concealed by fibrous folds.

The sinus receives the superior cerebral veins as above described, numerous veins from the dura mater (the covering of the brain), and, at the posterior extremity, veins from the pericranium, which pass through the parietal foramen.

The torcular Herophili is the dilated extremity of the superior longitudinal sinus. It is of irregular form, and is lodged on one side (generally the right) of the internal occipital protuberance. From it the lateral sinus of the side to which it is deflected is derived. It receives also the blood from the occipital sinus.

The inferior longitudinal sinus, more correctly described as the inferior longitudinal vein, is contained in the posterior part of the free margin of the falx cerebri. It is of cylindrical form, increases in size as it passes backwards, and terminates in the straight sinus. It receives several veins from the falx cerebri, and occasionally a few from the mesial surface of the hemispheres.

The straight sinus is situated at the line of juncture of the falx cerebri with the tentorium. It is triangular in form, increases in size as it passes backwards, and runs obliquely downward and backward from the termination of the inferior longitudinal sinus to the lateral sinus of the opposite side to that into which the superior longitudinal sinus is prolonged. It communicates by a cross branch with the torcular Herophili. Besides the inferior longitudinal sinus, it receives the superior cerebellar veins. A few transverse bands cross its interior.

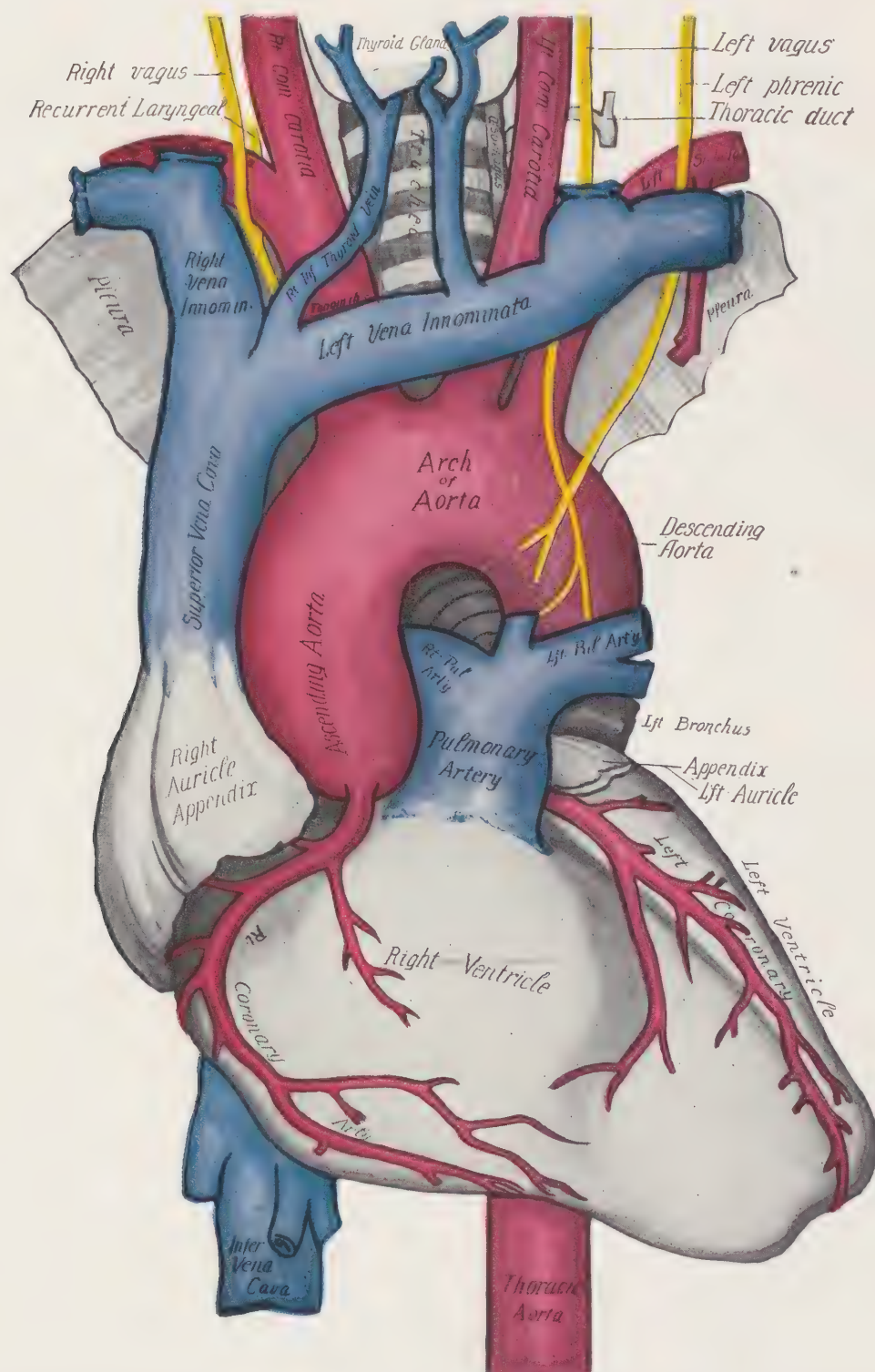
The lateral sinuses are of large size, and are situated in the attached margin of the tentorium cerebelli. They commence at the internal occipital protuberance, the one, generally the right, being the direct continuation of the superior longitudinal sinus, the other of the straight sinus. They pass horizontally outward to the base of the petrous portion of the temporal bone, then curve downward and inward on each side to reach the jugular foramen, where they terminate in the internal jugular vein. This is plainly seen on the colored supplement. Where the lateral sinus ends on the supplement, the internal jugular vein begins. Knowing as we do the nature of the blood, and the rapidity with which it undergoes chemical changes after death, it is reasonable to presume that the generation of gas in these sinuses will cause the blood to be shifted under pressure of this gas, and prevent the blood from gravitating from the external branches of the veins of the head. If the blood is not properly and thoroughly removed from the inner side of the skull, it is plain to see how gas will generate and assist in the congestion of these venous branches, thus causing discoloration of a more intense character.

If the reader will carefully study the colored supplement, and imagine the body lying on its back, the tendency of the blood to settle in the back part of the head must be understood. This accounts for the distention of the external jugular vein on the side of the neck when the embalmer is injecting fluid before removing blood from the body. This practice often results in fixing the discoloration in the parts from which it is impossible to remove. In order to overcome these obstacles, we have brought to our aid preparations that do not coagulate the blood, and even when they do become mixed during the injection of fluid into the arteries, this preparation turns the blood a pink color thus preventing the bluish leaden color so pronounced in many cases. Much depends upon the position given the body during the process of embalming. By studying the colored supplement, it will be plain to the reader that if the body is highly elevated, and the improved blood tube passed into the right auricle of the heart, it is an easy matter to remove the blood from the lateral sinus through the internal jugular veins. The passage of a non-coagulative preparation will quickly pass through the capillaries and cause the blood to be driven downwards through the various sinuses, thus draining not only the internal branches, but the external veins as well.

It is easy to understand how discoloration can be removed by using the channels that nature provided for the passage of blood during life. But, as before stated, much depends upon the elevation of the body so as to facilitate gravitation of the blood from the internal as well as the external portion of the head. If the preserving preparation employed coagulates the blood, it means fixing the discoloration at the points where the blood was located when coagulation was produced. Fortunately we have, after much experimentation, perfected a formaldehyde preparation that does not coagulate the blood, thereby permitting its free removal from the venous channels of the head. In this manner we are enabled to produce a more natural appearance of the remains without resorting to the application of paint and powder, so generally resorted to to conceal the putty, ashen and leaden color so objectionable to embalmers. Much can be said in favor of modern technique to produce these modern results. Modern technique is not generally understood by embalmers, and consists of treating each case in a particular manner, rather than simply raising an artery and vein as is usually done in all cases.

Again, a word may be said regarding the charges made in each case. If embalmers charged for each case according to the amount of work necessary, there would be less tendency of slighting their work because they are not adequately paid for the extra work so necessary in many cases. Surgeons charge for operations according to their importance, why should the embalmer not do likewise? Too many embalmers possess no knowledge of anatomy, and depend solely upon their knowledge of how to raise an artery and vein as the chief requisite for success in their work.

Plate No. 11. AORTA AND BRANCHES AND VEINS ENTERING HEART



This colored illustration shows the heart and large arterial and venous branches that are connected with it. The aorta which is printed in red and the pulmonary which is printed in blue are the two largest arteries in the human body. The two coronary branches are seen supplying the muscles of the heart on the right and left sides. The arch of the aorta gives off three branches which are plainly seen on this illustration. The first branch to the right is the innominate, which is seen to divide into the right sub-clavian and right common carotid arteries. The next branch is the left common carotid, and the third and last branch is the left sub-clavian. The pulmonary artery (blue) will be seen leaving the upper part of right ventricle of the heart. The superior and inferior venae cavae are also seen entering the upper and lower part of the right auricle of the heart. These large veins are used by the embalmer for removing blood from the venous system. The right auricle is sometimes punctured with the cardiac needle for the same purpose. It will be observed that the curve of the right innominate vein is more abrupt than that of the left. This has led to the belief that blood tubes can be introduced into the right auricle of the heart from the left side only, but it is equally as easy to perform this work from the right side, regardless of the sharp curve of the veins.

Plate No. 11 AORTA AND BRANCHES AND VEINS ENTERING HEART

The colored illustration of the aorta and branches and veins entering the heart, shows at a glance the main arteries and veins that serve the purpose of conveying blood from the heart to all parts of the body, and the veins that return the impure blood to the right auricle of the heart. The arteries are printed in red indicating the color of the blood they contained during life, while the veins are blue to indicate the color of the blood they return from all parts of the body.

It will be noticed that the aorta is divided into three sections, namely, the ascending portion, arch, and descending aorta. When the aorta passes into the abdominal cavity, it assumes the name of abdominal aorta. While the aorta is in the thoracic cavity, it is called the thoracic aorta. The colored illustration shows the arch of the aorta giving off three branches. The first to the right is the innominate artery which divides under the clavicle (collar bone) into the right common carotid and the right sub-clavian arteries.

The next branch that the arch gives off is the left common carotid and the last branch is the left sub-clavian artery. These three branches serve to convey embalming solutions to the head and arms, as well as supplying many parts of the body through which they pass by giving off many branches that are not seen on the colored plate. The first branches that the ascending aorta gives off are the coronary arteries that supply the outside of the right and left portions of the heart. The arch of the aorta sometimes gives off four branches, and the writer has some dissections taken from posted cases where the two common carotids and the two sub-clavian arteries are given off directly from the arch of the aorta. The aorta as it leaves the left ventricle of the heart is about the size of a garden hose, but as it descends on the left side of the vertebral column it gradually becomes smaller, at the same time giving off many branches not displayed on the colored illustration.

A careful study of the illustration will show why the fluid passes into the arteries of one side of the head more freely than it does into that side of the head where the injection is made by opening the right common carotid artery. If the carotid artery on the right side is employed as a point for injecting the preserving solution, it is quite natural that fluid will pass more freely through the left common carotid that has not been opened, while on the right side the fluid will be injected downwards to the detriment of the passage of fluid into the upper part of the carotid. If the face is injected upwards, after the injection of the body has taken place, much care must be exercised, otherwise that side of the face will present a contrast to the other. Of course the carotids are not employed as extensively as in years gone by, due to the mutilation of the neck, and the severing of many venous branches that cause a profuse escape of blood which obscures the work of the embalmer and makes this part of the work disagreeable.

If fluid is injected into the axillary from the right side, a glance at the colored plate will convince the reader that the fluid has a better chance of equal distribution through the two common carotids than if one of these carotids is used as a point for injection. The passage of fluid through the right

sub-clavian artery is accommodated by the extra size of the innominate which cares for the fluid passing through it and also permits of a free passage of fluid into the right common carotid artery. As the body is elevated (and this is a very important feature of the passage of fluid into the lower extremities, for if the body is not elevated so as to facilitate gravitation to the lower parts of the body first, the fluid will find its way into the head first, and then be forced into the lower parts of the body); if the body is well elevated from the hips upwards, the position of the body will cause the fluid to pass into the arch of the aorta, thence into the descending aorta and lower parts of the body.

When these parts have become filled with fluid, it naturally seeks those remaining branches that have received no fluid and usually the head is the last part of the body to be filled. Too much cannot be said regarding elevating of the body, for, aside from the passage of fluid into the arteries of the lower extremities, the removal of blood from the head through the internal and external jugular veins, is facilitated by the elevated position. The internal jugulars are seen where they unite with the sub-clavian veins to form the vena innominata. The two thyroid veins are seen terminating in the left innominate vein, and it is the cutting of these veins when the carotid is being raised that permits the escape of blood which obscures the work of the embalmer.

The superior from the top and the inferior from the bottom are seen entering the upper and lower parts of the right auricle of the heart. These are the large veins that we use with the improved blood tube to withdraw blood from the termination of the venous system in the right auricle. If the body is properly elevated from the hips upwards, it will be plain how the blood is withdrawn from the head first, and should there be a congestion of blood in the venous system, the discoloration it produces will be removed first, and the injection of fluid may follow. If the fluid is first injected, it may find its way into the venous circulation and cause coagulation of the blood in the head thereby fixing the discoloration so that it will appear a leaden blue color the following day, or even a few hours afterwards. If the blood is withdrawn from the venous system before any fluid is injected, the possibilities of a leaden blue colored head will be reduced to a great extent. It is for this reason that we employ fluids that cause the blood to turn a pink color, thereby imparting a pinkish color to the features instead of a leaden blue.

If the arteries are injected first, the embalmer will observe the distended condition of the external jugular vein indicating that great pressure exists, and this distention of the external jugular vein does not appear until the pressure of fluid injected into the arteries manifests itself in the venous system. This often causes flushing or a pronounced form of discoloration of the head and neck, and after the fluid has exerted its influence on the blood, coagulation renders its removal impossible.

If the blood is first removed from the right auricle of the heart with the improved blood tube there will be no flushing or consequent discoloration. If the blood is first removed from the heart, even if discoloration still remains, the massaging of the

features, usually resorted to by the embalmer, will easily cause the blood to flow downwards from the face into those venous branches that have been drained of their bloody contents.

The colored illustration must make this point clear, for the right auricle of the heart receives all the blood from the upper and lower portions of the body through the superior and inferior vena cava, and if the body is properly elevated, and the blood is in a condition whereby its removal is possible it is reasonable to suppose that the blood will freely flow from the head downwards into the right auricle of the heart from which point we remove it with the improved blood tube. The colored illustration shows the internal jugulars uniting with the sub-clavian veins to form the innominate veins which unite to form the superior vena cava which is seen terminating in the upper part of the right auricle of the heart which is plainly marked.

It is from this part of the heart that we remove blood with the improved tube, and as the body is elevated, it is plain to see how we drain the head first, thereby preventing discoloration, and if discoloration is already present, we remove the blood from the head first to relieve the congestion and remove discoloration.

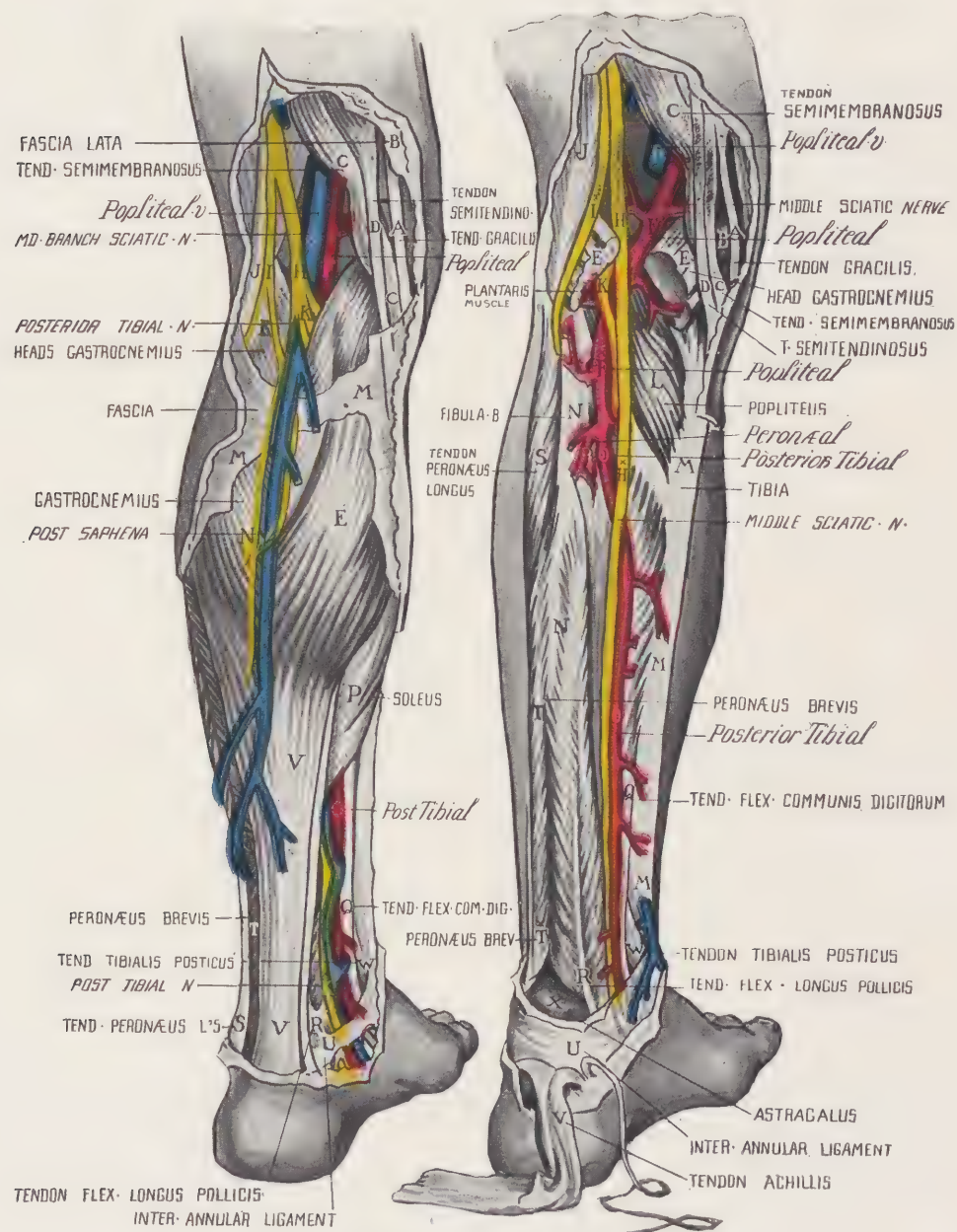
In the article on Plate No. 10 we showed by the illustration of the cranial sinuses how the blood was drained from the inner side of the skull during life, and also what an important bearing this sinus has upon the removal of blood from the head after death. If fluid is first injected into the arteries, the sinus on the inner side of the skull is over-filled with blood due to the fluid injected into the arteries driving it before it, and this causes the blood to press downwards upon the internal and external jugular veins which have not been relieved of their bloody contents, and distention of these vessels is the result.

This explanation must make it clear to the reader why it is necessary to first remove blood from the venous system before injecting fluid that will coagulate the blood.

It is much easier to prevent discoloration than it is to remove it after it once has been formed, and if it is allowed to harden, the discoloration becomes fixed and there is nothing that will remove it. This has led to the camouflage of the face by applying various colored substances so as to conceal the fixed discoloration that even the embalmer dislikes. If the usual tube is inserted into the sub-clavian vein on one side by introducing the tube into the axillary vein, the blood is drained from one side more than from the other and the results are not as satisfactory as if the blood was drained from the right auricle of the heart thereby relieving the jugular veins on both sides of the head at the same time.

The autopsy reveals the truthfulness of the above assertion, for in the course of training the tubes are first inserted in the veins and when the body is afterwards opened, the exact position of the tube is exposed. All these methods are a part of the thorough training given in practical modern embalming, so that the student knows before leaving school just what he is capable of doing.

Plate No. 12. POPLITEAL, POSTERIOR TIBIAL, PERONIAL ARTERIES, AND VEINS



The popliteal artery (marked F) is seen passing through the popliteal space behind the knee. This artery is accompanied by the vein of the same name (marked G) lies on the outer side and superficial to it. The anterior tibial which is not marked with any letter will be seen branching off at a point slightly above where the posterior tibial (marked O) and the peroneal (marked P) is given off by the popliteal artery. In the illustration on the left will be seen the posterior saphenous vein passing over the calf of the leg and terminating in the popliteal vein. The two posterior tibial veins will be seen following the artery of the same name, and these terminate in the popliteal also. The popliteal space is plainly seen in the illustration on the left. The anterior and posterior tibial arteries unite under the foot to form the plantar arch, which sends branches that supply the toes.

Plate No. 12. POPLITEAL, POSTERIOR TIBIAL, PERONIAL ARTERIES, AND VEINS

This colored plate will convey a clear picture of the arteries and veins supplying the lower extremities. The chart shows the popliteal space, with the popliteal artery (marked F) and the popliteal vein (marked G).

The posterior saphena vein (marked N), which receives superficial branches from the ankle. The chart also shows the peroneal (marked P) and the posterior tibial (marked O). The anterior tibial is not displayed on either drawing, it being situated in the front of the leg. The posterior tibial is seen in the lower portion of the leg accompanied by the two posterior tibial veins. Only a small portion of the peroneal artery is seen in the illustration on the right. The popliteal space is seen in the upper portion of the left illustration, corresponding to a point behind the knee. It is lozenge shaped and widest at the back part of the knee joint. It contains the popliteal artery (marked F) and the popliteal vein (marked G) with their branches, together with the termination of the external saphenous vein the internal and external popliteal nerves and some of their branches, the lower extremity of the small sciatic nerve, a few lymphatic glands, and a considerable amount of loose adipose tissue.

The popliteal artery commences at the termination of the femoral at the opening in the adductor magnus, and, passing obliquely downward and outward behind the knee joint to the lower border of the popliteus muscle, divides into the anterior and posterior tibial arteries. A portion of the artery lies in the popliteal space; but above, to a slight extent, and below, to a great extent, it is covered by the muscles which form the boundaries of the space, and is therefore beyond the confines of the popliteal hollow.

The popliteal vein, which is closely attached to the artery, lies superficial and external to it until near the termination of the artery, when the vein crosses it and lies to its inner side.

The posterior tibial artery is of large size which extends obliquely downward from the lower border of the popliteus muscle, along the tibial side of the leg, to the fossa between the inner ankle and the heel, where it divides into the internal and external plantar arteries. At its origin it lies opposite the interval between the tibia and fibula; as it descends, it approaches the inner side of the leg, lying behind the tibia, and, in the lower part of its course, is situated midway between the inner malleolus and the tuberosity of the os calcis. In the lower third, where it is more superficial, it is covered only by the integument and fascia, and runs parallel with the inner border of the tendo Achilles. It is accompanied by two veins, and by the posterior tibial nerve, which lies at first to the inner side of the artery, but soon crosses it, and is, in the greater part of its course, on its inner side.

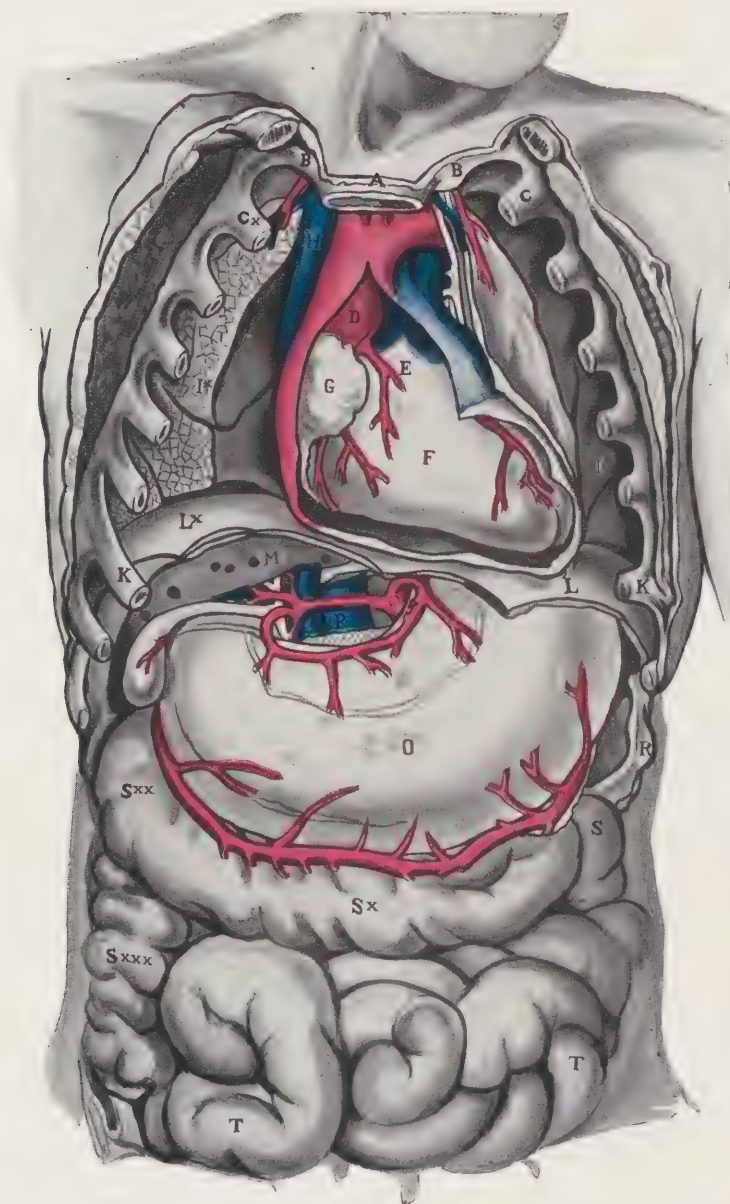
The peroneal artery lies, deeply seated, along the back part of the fibular side of the leg. It arises from the posterior tibial about an inch below the lower border of

the oppliteus muscle, passes obliquely outward to the fibula, and then descends along the inner border of that bone to the lower third of the leg where it gives off the anterior peroneal. It then passes as the posterior peroneal, across the articulation between the tibia and fibula to the outer side of the os calcis, where it gives off its terminal branches, the external calcanean. The peroneal artery gives off various branches to supply the muscles. These branches are not visible on the colored illustration.

The posterior tibial artery plays an important part in our work when washing blood out of the arteries in cases of sudden death, especially in the bodies of females. To raise the posterior tibial artery near the ankle, a small incision should be made through the integument, midway between the heel and inner ankle, or a little nearer the latter. The subcutaneous cellular tissue having been divided, a strong and dense fascia, the internal annular ligament, is exposed. This ligament is continuous above with the deep fascia of the leg, covers the vessels and nerves, and is intimate adherent to the sheaths of the tendons. This having been carefully divided upon the director, the sheath of the vessels is exposed, and, being opened, the artery is seen with one of the venae comites on each side. The vessel is then separated with the handle of the aneurism needle, after which ligatures are passed under the artery in preparation for the opening of this vessel.

The posterior tibial artery is used as an outlet for the passage of blood that is washed from the arterial system in cases where the washing out of the arteries is necessary owing to the large amount of blood they may contain when death is sudden. This artery is used for ethical reasons, and especially when there is no female embalmer to be had to care for the case. If a female embalmer is employed to do the work, the femoral artery may be employed as in the case of a male. We may add at this point that the entrance into this profession of women embalmers of more than ordinary skill has made the use of the posterior tibial artery for the purpose of washing blood out of the system, of rare occurrence. The war caused many women to take up the work of embalming to replace the men who have been called to the front, and they met with marked success in their new calling. These women did many men's work, even to the conducting of the funeral in all its details. I received many letters from women who were compelled to replace their husbands who were called to the colors, and their accounts of compliments paid by members of the family and friends at the careful and delicate manner in which they perform their work, were very gratifying. The scarcity of men assistants caused this increased in the attendance at the schools. In some cases the daughter of an undertaker took the place of a son who was drafted, and in other cases it was the wife who was left with an established business in her care. It is gratifying to note the generous support given these patriotic women when performing work that had hitherto been monopolized by the male sex.

Plate No. 13. THORACIC AND ABDOMINAL VISCERA WITH ARTERIAL BRANCHES



- A·UPPER STERNUM
- B·FIRST RIB
- C·SECOND RIB
- D·Aorta
- E·Pulmonary
- F·RT. VENTRICLE
- G·RT. AURICLE
- H·Vena Cava Sup.
- I·LUNGS
- K·SEVENTH RIB
- L·DIAPHRAGM
- N·GALL BLADDER
- O·STOMACH
- P·Inf. Vena Cava
- Q·Cœliac axis
- R·SPLEEN
- S·TRANSVERSE COLON
- S^{xx}·ASCENDING COLON
- T·SMALL INTESTINES

This colored anatomical chart illustrates the abdominal and thoracic viscera, as well as many of the large branches given off by the aorta. The ascending portion of the aorta is marked (D), the pulmonary artery is marked (E). The right and left coronary arteries are seen branching over the sides of the heart. The thoracic cavity contains the heart and lungs. Surrounding the heart is a sack which has been partly removed so as to expose the position of the heart. The lungs are marked (I). Immediately below the diaphragm is the liver and stomach, marked (M and O). The coeliac axis is seen immediately below the diaphragm, giving off the hepatic artery which passes to the right and supplies the liver. The gastric supplies the upper curve of the stomach, and a branch of the splenic artery is seen following the lower curve of the stomach and terminating in the hepatic artery. The transverse colon is marked (Sx), the ascending colon is marked (Sxxx), and the small intestines are marked (T). It is important that the embalmer become acquainted with these arterial branches as well as the organs and glands they supply, so as to permit him to perform the cavity work with the least danger to the circulation.

Plate No. 13. THORACIC AND ABDOMINAL VISCERA WITH ARTERIAL BRANCHES

This colored plate will serve to guide the embalmer in performing that portion of his work which deals with the irrigation of the cavities contained in the trunk of the body. The thoracic and abdominal cavities are exposed with their contents. The diaphragm (marked Lx and L) separates these cavities. The diaphragm is a muscular partition which assists respiration during life. In the thoracic cavity we see the lungs (marked I) and the heart (marked F). Surrounding the heart is a sac called the cardiac sac. This sac serves to sustain the heart. The superior vena cava (marked H) and the inferior vena cava (marked P) terminate in the right auricle of the heart (marked G). It is this portion of the heart from which the blood is removed by means of the improved blood tubes. Below the sternum the stomach (marked O), the liver (marked M), the gall bladder (marked N), the spleen (marked R), the large and small intestines (marked T, S, Sx, Sxx and Sxxx). This supplement is of especial interest to embalmers as a study of the location of the various organs and glands, as it indicates the points where the aspirating and injecting needles must be introduced in order to aspirate the liquids and gas, as well as the injection of preserving solutions.

Much has been said for and against cavity embalming in conjunction with the injection of the arteries. Some claim it is not necessary to inject the cavities when the arteries are injected. This has led to much confusion as well as disappointment in many cases. It is just as necessary to inject and sterilize the hollow cavities as it is to sterilize the tissues in other parts of the body.

Some claim that as the inner portions of the body are not exposed, there is no danger of infection from this portion of the body. This argument does not hold good, for the escape of liquids from the mouth and nose as well as from the intestinal tract and urinary bladder are sources of infection, not to say anything of the danger to those in charge of the remains. Those who have had any experience in handling and caring for the dead, must admit that the aspiration of gas and liquids, from the trunk of the body is necessary in nearly all cases where the body is to be kept for only a few days, and when the weather is hot, this becomes still more imperative.

First, the irrigation of the air cells of the lungs is necessary in all cases, if the escape of white froth mixed with blood is to be prevented. Secondly, the escape of liquids from the mouth is prevented by aspirating these substances from the stomach by the use of the new aspirating needle. The fact that the gastric and splenic arteries supply the walls of the stomach with blood during life and fluid after death does not mean that they also convey preserving fluid to the liquid contents of the stomach after death.

If the stomach is filled with liquid food before death, these substances undergo fermentation and produce gas in such quantities that the stomach as well as the large and small intestines become distended, and thus create a great pressure on these parts, forcing the liquid contents of the stomach upwards through the oesophagus and mouth and sometimes through the nostrils. The careful passage of the aspirating needle into the intestinal tract to relieve the accumulated gas is of vast importance. The disinfection of this tract is very necessary in all cases where the preservation of the body is to be insured, especially in shipping cases. It is of the utmost importance when irrigating the pleural cavities, which are plainly seen on the colored supplement, that the needle be introduced so as not to injure the lung tissue, otherwise there may be a hemorrhage of fluid and blood from the mouth and nostrils owing to laceration of the lung tissue by the ignorant use of the aspirating needle. If the reader will carefully note the position of the red arterial branches as they supply the upper and lower border of the stomach, it should be plain why the passage of the aspirating needle must be directed with great care so as not to injure these branches. When these branches are injured by the unskillful passage of the aspirating needle, fluid and blood usually escape from the opening made in the wall of the abdomen, for the purpose of doing the cavity work.

With modern technique and our ability to preserve the natural external features, it is also necessary to employ this technique for the preservation of the internal parts of the trunk of the body. If embalming or, as it might be called with a greater degree of exactness, the modern sanitary preservation

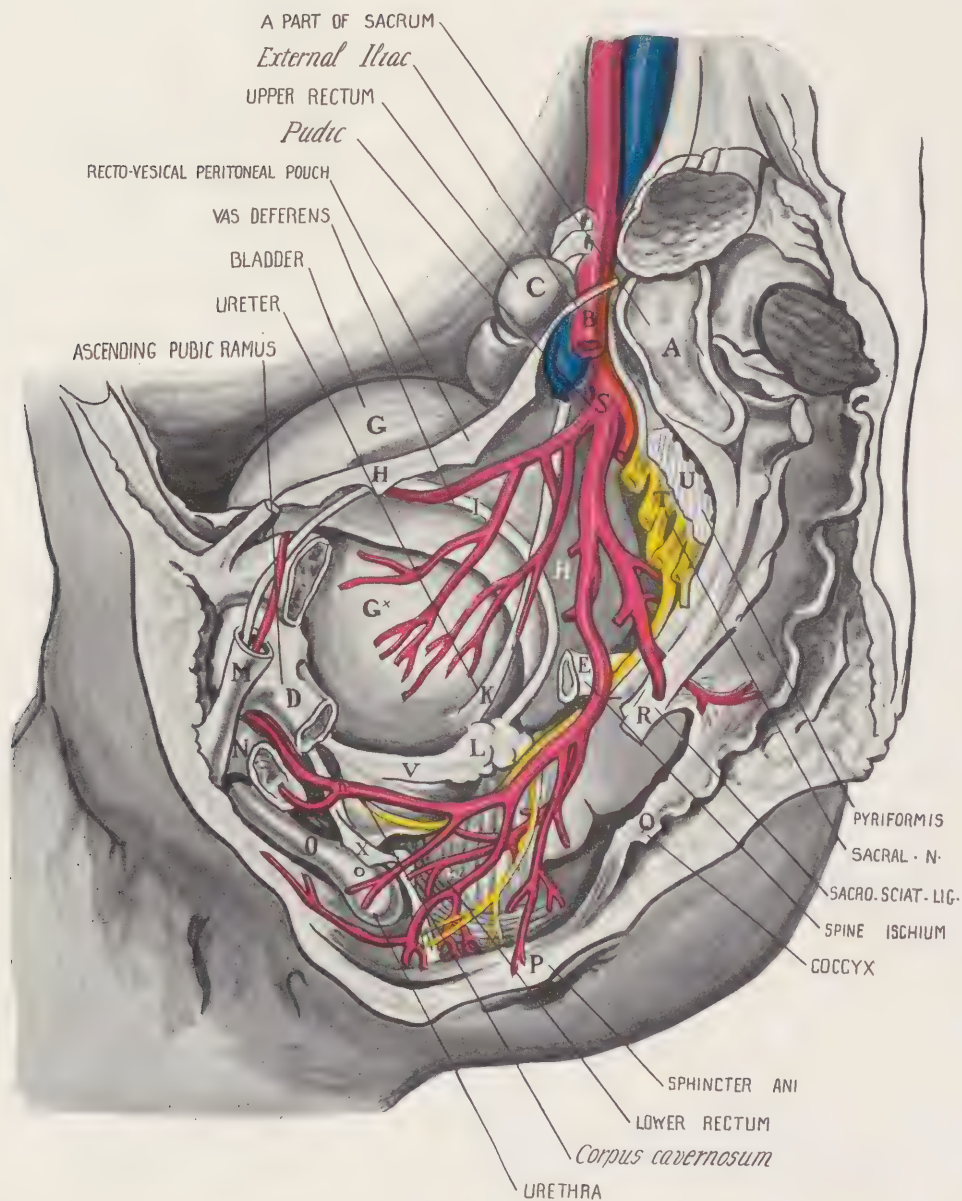
of the human dead is to be a sanitary measure, it must be carried out in all of its details so as to insure the sterilization of the human remains. If, as so many seem to think, embalming is intended to keep a body for a few days at most, cavity work may be dispensed with, but, even in those cases, the necessity for aspirating from the cavities becomes necessary after the liquid contents of the hollow organs and glands have had time to undergo fermentation. We are now able to preserve the natural flexible velvety texture of the human dead skin; we are now able to prevent purging; we are now able to sterilize the entire dead body. If all of the above conditions could not be fulfilled, our technique would be faulty, as it is in so many cases where the operator is untrained in his work.

The necessity for knowing the location of the various organs and glands in the trunk of the body must be apparent to all, and the necessity for doing the work in such a manner that the arterial branches that supply their substance will not be injured, must appeal to all intelligent readers of this article. When gas forms in these hollow organs and glands, they press upon the large blood vessels, thereby forcing the blood into the face and neck and producing discoloration. This condition does not occur if the cavities are properly aspirated and injected. The formation of gas in the muscles of the neck and shoulders is often attributable to the failure of the operator to care properly for the hollow cavities contained in the trunk of the body.

In modern embalming technique, cavity work is taught in such a scientific manner that the danger of injuring arteries is reduced to a minimum. If embalming fluid is not injected into the hollow cavities of the body, putrefactive changes will certainly take place in the stomach, intestinal tract, urinary bladder, cardiac sac, pleural cavities and peritoneal lining.

It is very unwise to wait for serious conditions to develop before we attempt to check them. It is better to prevent them in the first place. It is always easier to prevent decay than it is to check it after it has progressed to any great extent.

Plate No. 14. ARTERIES OF THE PELVIS



This colored supplement illustrates the pelvis and arteries that supply the viscera and walls. The abdominal aorta divides into the two common iliac arteries. The common iliac arteries are about two inches in length, and pass downward and outward to the margin of the pelvis, where they divide into the external and internal iliac arteries. The external iliac, supplying the lower extremity, the internal supplying the viscera and walls of the pelvis, the generative organs, and inner side of the thigh. The external iliac artery is marked (B), and the pudic artery, marked (S), is the smaller of the two branches of the internal iliac, and supplies the organs of generation. The bladder marked (G) is supplied by branches of the pudic artery, as well as the rectum and muscles back of the thigh. These arteries play an important part in our work as embalmers, and great care should be exercised not to destroy them with the cavity needle when performing the cavity work.

Plate No. 14. ARTERIES OF THE PELVIS

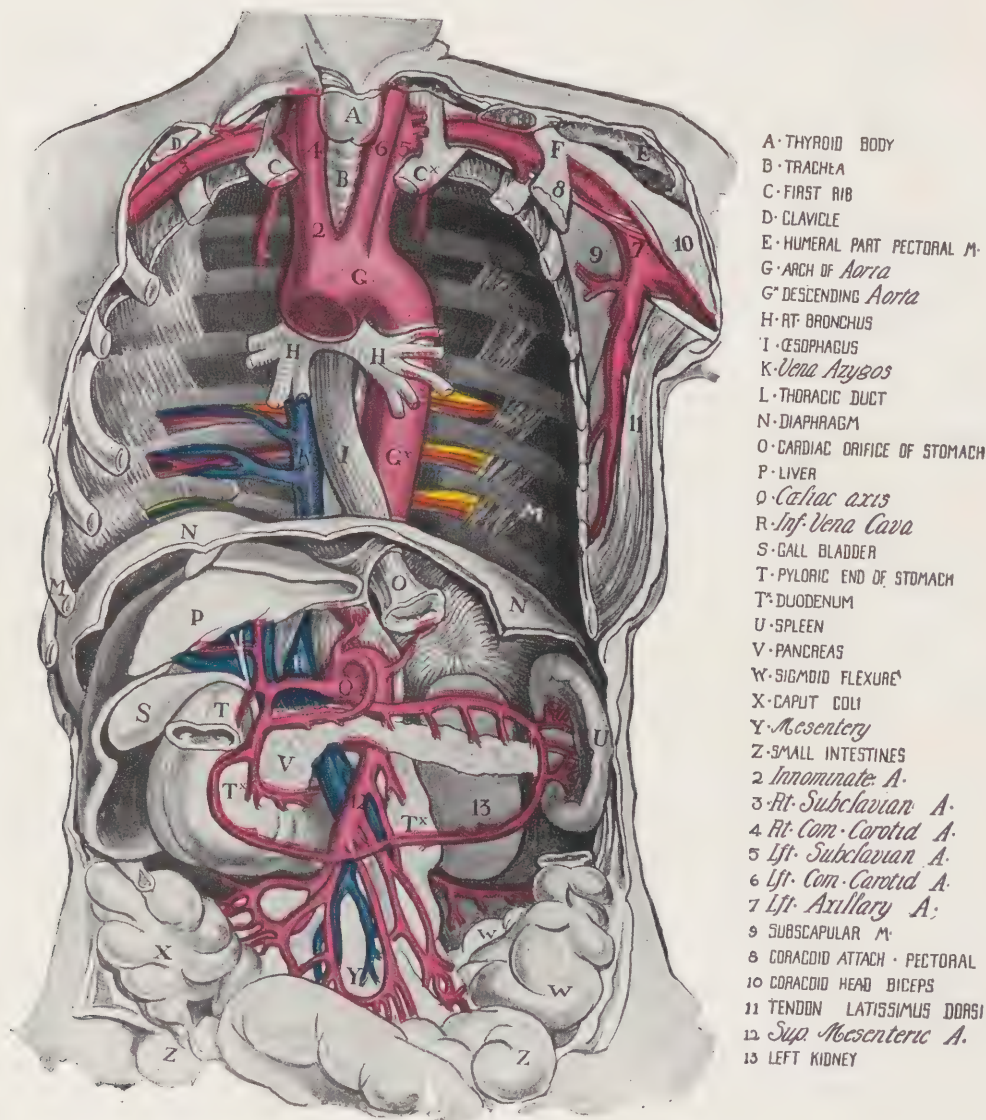
This chart illustrates the arterial branches that supply the organs and muscles of the pelvic cavity. The abdominal aorta divides into the two common iliac arteries, which are about two inches in length and which pass downward and outward to the margin of the pelvis, where they divide into the external and internal iliac arteries. The external iliac artery passing downwards over the brim of the pelvis and under Poupart's ligament, where it enters the thigh to become the femoral artery and supplies the lower limb. The external iliac artery (marked B and accompanied by the large external iliac vein which is not marked with any letter, but is printed in blue). As the iliac artery passes down over the margin of the pelvis it is divided into the external and internal iliac arteries. The internal iliac artery supplies the viscera and walls of the pelvis, the organs of generation, and inner side of the thigh. The pudic artery (marked S) is the smaller of two branches of the internal iliac and supplies the organs of generation. The bladder (marked G), is supplied by branches of the pudic artery which also supplies the rectum and muscles back of the thigh. The large external iliac vein which is printed in blue shows the course that the improved blood tube has to follow when passing into the inferior vena cava to reach the right auricle of the heart. It will be observed that the bladder occupies a position immediately behind the symphysis pubes. The coccyx is the termination of the vertebral column, and is marked (Q), and the sacrum is marked (A). The lumbar muscles can be seen above the part of the sacrum marked (A). The pelvic cavity is claimed as a separate cavity by some anatomists and as a part of the abdominal cavity by others, so that this remains an open question. The sphincter ani, which is marked (P), plays an important part in chronic diarrhea, and care should always be taken to properly bandage the body before lifting from the bed to the embalming board, otherwise watery discharges may result thereby causing much extra work in cleaning. The same may be said of dysentery, and careful bandaging is always recommended before removal of body from bed.

The colored illustration serves to show the great importance of carefully doing the cavity work, especially when passing the aspirating needle into the pelvic cavity. As the urinary bladder is usually found filled with urine, if it is not properly withdrawn with the aspirating needle, fermentation will soon take place and the pressure resulting from gas in the bladder will force the urine out through the natural channel. The aspirating needle should never be passed downward following the median line as there is much danger of rupturing the neck of the bladder, which would result in a discharge of urine.

The needle should be passed downwards midway between the median line of the body and a point midway between the crest of the ilium and the symphysis pubes. In this manner the side of the urinary bladder is entered by the point of the aspirating needle and the urine is removed into the empty bottle provided for this purpose. The other side of the bladder is entered in the same manner. Great care should be exercised when doing this work so as not to injure the external iliac artery, otherwise the fluid will escape into the pelvic cavity thereby draining fluid from the arterial branches located in the upper part of the trunk of the body, which will permit the upper part of the body to remain unprotected and putrefactive changes will result. This may be the cause of fluid and blood escaping from the opening made by the embalmer when doing the cavity work, thereby necessitating the sewing up of the opening in the walls of the abdomen, as is so often the case.

When passing the needle into the abdominal cavity for the purpose of removing gas and liquids, great care should be exercised not to pass the needle down too deep when entering the pelvic cavity, otherwise the needle will injure the bifurcation of the abdominal aorta where it gives off the two common iliac arteries. The needle should never be depressed so it will enter the pelvic cavity lower than the middle depth of the body. In this manner destruction of the arteries entering this cavity is prevented. When introducing the aspirating needle into the abdominal cavity, never point the needle downward, but carefully pass it to the left side so that in case of suddenly entering the abdominal cavity it would pass into the stomach instead of injuring the lower portion of the abdominal aorta. This may be another cause for leakage from the opening made in the walls of the abdomen when doing the cavity work. By turning the sheet containing the colored supplement sideways and looking at it from the right side, which will represent the position of the parts as they would appear when the body is lying on its back, it will be plain to see how easily the puncturing of the arterial branches can be accomplished if a knowledge of these parts is lacking, and the manipulation of the aspirating needle is not understood. This part of the operation plays an important feature in the successful performance of that part of the cavity work dealing with the elimination of urine from the bladder as well as gas from the descending and ascending portions of the large colon, not to mention the important portion of the small intestines located in this portion of the abdominal cavity.

Plate No. 15. THORACIC AND ABDOMINAL AORTA WITH MAIN BRANCHES



This colored chart illustrates the main branches of the aorta. The trunk of the body is divided by means of the diaphragm (N), into the thoracic and abdominal cavities. The thyroid gland is marked (A). Trachea (wind pipe) is marked (B). This illustration shows the arch of the aorta marked (G), giving off three branches marked (2) innominate artery (6), left common carotid artery (5), left subclavian artery. That portion of the aorta marked (G^x) is the descending portion of this large trunk, and it will be observed that it gives off the intercostal arteries, a few of which have been added at that point. The course of the sub-clavian artery is best seen by looking at that portion marked (3), where the artery passes over the first rib marked (C) and under the clavicle marked (D). This will also convey an idea of the course the improved blood tube follows when being introduced into the right auricle of the heart for the purpose of removing blood. The vein marked (K) is the vena Azygos, which connects the superior and inferior venae cava. Immediately below the diaphragm will be observed the first important branch of the abdominal aorta known as the coeliac axis marked (Q). The coeliac axis gives off three branches called the hepatic, gastric and splenic arteries. These branches can be easily traced as they follow the upper and lower curve of the stomach, which has been removed in order to show their course. The next important branch illustrated on this colored plate is the mesenteric artery marked (12), which supplies the entire length of the small intestines as well as the ascending and transverse colon. These vessels play an important function in the distribution of fluid to the abdominal viscera.

Plate No. 15. THORACIC AND ABDOMINAL AORTA WITH MAIN BRANCHES

This plate gives a good idea of the manner in which the preserving solution is distributed to the viscera of the trunk of the body. It is easily seen how the aorta (marked G and GX), give off branches that supply the organs and glands contained in the thoracic and abdominal cavities. The trunk of the body is divided by the diaphragm (marked N), into the thoracic and abdominal cavities. The thyroid gland (marked A). Trachea (wind pipe) is marked (B). The accompanying illustration shows the arch of the aorta marked (G), giving off three branches marked (2), innominate artery (6), left common carotid artery (5) left sub-clavian artery. That portion of the aorta marked (G) is the arch, that marked (GX) is the descending portion of this large trunk artery which gives off the intercostal branches on either side. These branches supply the spaces between the ribs, the muscles of the back and chest in front. The course of the sub-clavian artery is seen by looking at that portion marked (3) where it passes over the first rib and under the clavicle marked (C and D). The course of this artery will give the reader an idea of the course that the improved blood tube must travel to enter the right auricle of the heart, from which point the blood is removed from all parts of the body. The vein marked (K) is the vena azygos, which serves as a connection between the superior and inferior venae cava which drain the blood from the upper and lower parts of the body during life, and we use these large venous branches for the same purpose after death. Immediately below the diaphragm we see the first large branch given off by the abdominal aorta and known as the coeliac axis (Q). The coeliac axis is seen to give off three branches which are known as the hepatic, gastric and splenic arteries. The stomach has been removed thereby revealing the position and course these branches follow in supplying the upper and lower curves of the stomach, as well as those passing to the spleen, liver and pancreas. The next large branch given off by the abdominal aorta immediately below where the coeliac axis begins, is the superior mesenteric artery (marked 12), which supplies the entire length of the small intestines also the ascending and transverse colon, liver (P), gall bladder (S), pancreas (V), kidney (13), spleen (U), end of oesophagus where it terminates into stomach (O), where small intestines begin (T), first section of small intestine (TX), bronchial tubes (H). This illustration gives the reader a very clear idea of the large branches we depend upon for the distribution of preserving solutions as well as those vessels that are mutilated when an autopsy is held. It must also

be clear to the reader how injury is inflicted upon the branches given off by the coeliac axis when the stomach is removed for medico-legal examination where death is suspected as the result of poison having been administered. We can also see at a glance how the preserving liquids are conveyed to the hollow organs in the abdominal cavity to prevent the formation of gases that cause so much annoyance to the embalmer.

This illustration also shows the course that the liquid follows when injected into the arteries from any point, and the consequent distention of the abdomen as the result of the filling up of these arterial branches. When fluid passes through the branches that are shown supplying the upper and lower curves of the stomach, as well as those of the large and small intestines, it causes pressure which often causes the liquid contents of the stomach to escape from the corners of the mouth and sometimes from the nose. This illustrates the necessity of always making the body purge before the injection of the arteries is begun, otherwise the operation may have to be suspended while this part of the work is carried on.

By observing the formation of the right sub-clavian with the right common carotid artery, it will be easy to see how the right side of the neck and right shoulder become enlarged and hard when the fluid is injected too rapidly with a strong formaldehyde solution. This condition would manifest itself on either side when the axillary artery is employed as a point for injection, if the pressure exerted by the pump or syringe is too great for the capacity of the arteries at that point. It will also show the unequal distribution of fluid to the head and neck when either of the carotid arteries is employed as a point for injection. In this illustration the bronchial arteries which supply the substance of the lungs are not seen, but the fluid passing through them often causes the escape of white froth from the mouth and sometimes from the nostrils, especially when the air cells of the lungs are not injected separately with preserving fluid. The mucous linings of the bronchial tubes undergo putrefactive fermentation very quickly after death, more so in children than in adults, and if preserving liquids are not injected directly into the bronchial tubes with the improved nasal tube, purging of white froth may be expected to appear shortly after the injection of the arteries has begun.

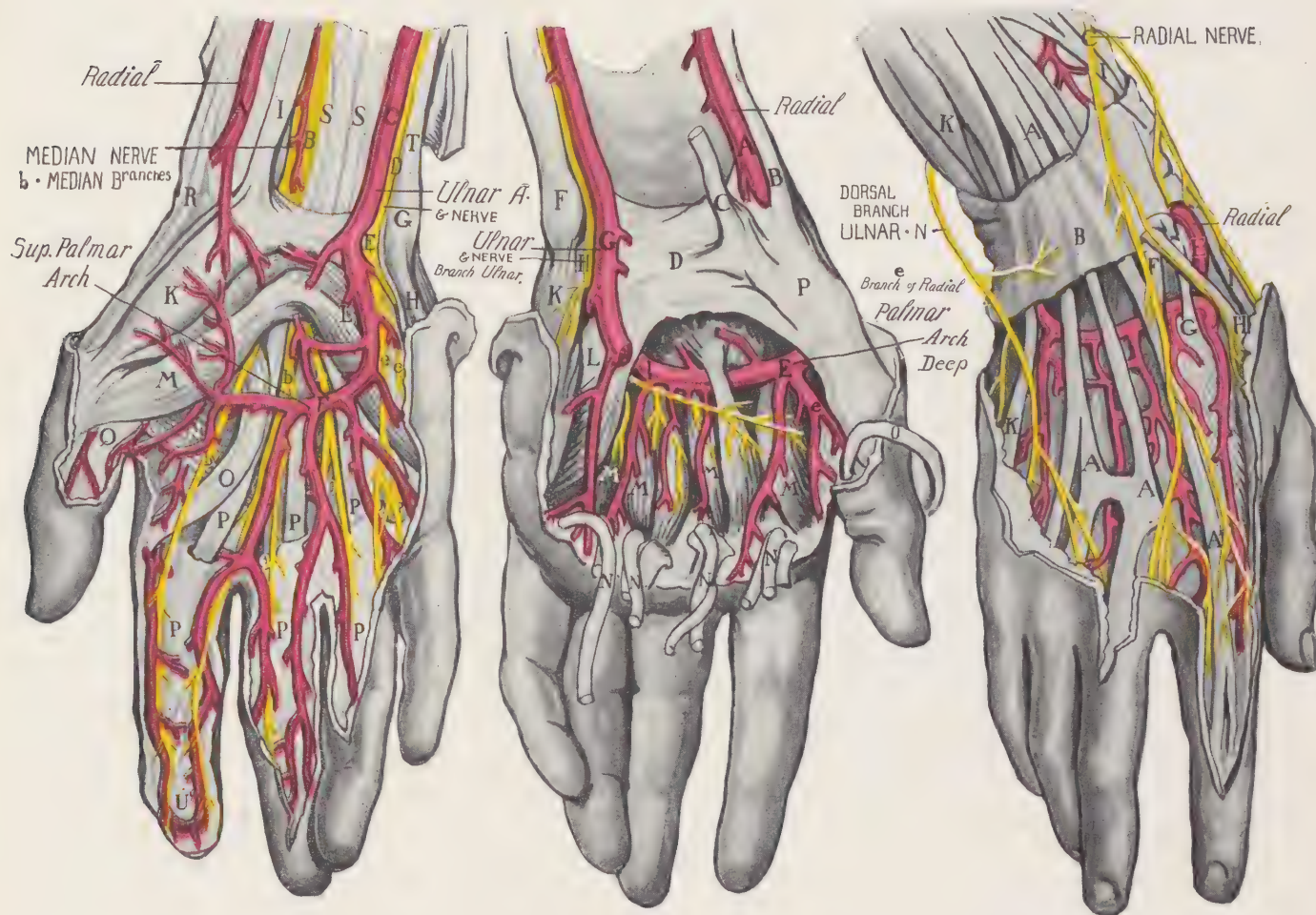
If the body is elevated from the hips upwards, as is usually done when the best results are to be obtained, it is easy to see how the position of the body facilitates the downward passage of the preserving liquids from the point of injection. In some cases there are partial obstructions in the aorta

which may hinder the passage of the fluid thereby causing the fluid to pass into the head and neck first, thereby conveying the fluid downwards as rapidly as when injected, giving the impression to the untrained embalmer that the required amount of fluid has been injected. The appearance of fluid in the arteries of the head soon after injection is begun is no true sign that the body has received sufficient fluid, but of the rapid injection of fluid, and the partially obstructed aorta cannot accommodate the fluid rapidly enough to prevent this congested condition of the arteries of the upper part of the body.

The weight of the body and the necessary amount of preserving solution to be used are the main factors in thorough preservation, not the appearance of the distended temporal arteries. When the stomach is removed for medico-legal examination, the mutilation of the arteries that supply the upper and lower curves of the stomach is an assured fact, and the injection of the arteries from those points is easily understood by consulting the colored supplement. The injection of the body from the point of mutilation is an easily accomplished operation, and the injection of fluid from the same point into the cavities of the chest and abdomen is easy of accomplishment by passing the needle through the large opening made for the removal of the stomach. Of course, it is very necessary to relieve the gas contained in the intestinal tract as well as inject fluid into their hollow cavities to properly care for the foecal contents, otherwise this matter will undergo putrefactive changes and generate gas thereby distending the abdomen, causing pressure on the blood vessels which will result in forcing the blood upwards into the head and neck, resulting in discoloration of those parts. If pressure is permitted to exert itself on the stomach, it will force the liquid contents upwards and cause purging from the mouth and nose. It will be seen that the mesenteric arteries supply the walls of the intestines and not their foecal contents, hence the necessity for first removing the gas from the intestinal tract, and afterwards injecting preserving liquids into them. We may say the same of the stomach which should always receive the same treatment in all cases where thoroughness is desired.

The technique of cavity embalming is of as much importance as that of arterial injection. To have a clear understanding of the arterial system, the amount of liquid required to reach all parts, the removal of blood, and a thorough training in modern technique are the essentials of success. With modern preparations that give the blood a natural pink color, natural suppleness of the body, failures should be a thing of the past.

Plate No. 16. SUPERFICIAL AND DEEP PALMER ARCHES



The above chart shows the deep and superficial palmar arches with their digital branches. These branches play an important part in the distribution of embalming solutions to the hands and ends of the fingers. It is by means of these small digital branches that the fluid is conveyed to the ends of the fingers to turn the blood a pink color under the nails, thus imparting a more natural color. The radial artery marked (A), and the ulnar artery marked (C), unite in the palm of the hand to form an arch; one is superficial and the other is deep seated. These are known as the superficial and deep palmar arches marked (F and E). It will be observed that the palmar arch gives off a number of smaller branches known as the digital arteries which supply the ends of the fingers.

Plate No. 16. SUPERFICIAL AND DEEP PALMER ARCHES

This colored plate illustrates the arteries that perform such an important part in the distribution of the embalming solution to the hands. The three illustrations show the internal and external, or deep and superficial arches. In order to give the reader an idea of the formation of the palmar arches it may be advisable to first describe the radial and ulnar arteries, and their ultimate anastomoses to form the palmar arches. The radial artery appears from its direction, to be the continuation of the brachial, but in size it is smaller than the ulnar. (Radial artery marked A on plate). It commences at the bifurcation of the brachial, just below the bend of the elbow, and passes along the radial side of the forearm to the wrist, when it will be seen to wind backward around the outer side of the carpus, beneath the extensor tendons of the thumb, and finally to pass forward between the two heads of the first dorsal interosseous muscle, into the palm of the hand, where it crosses the metacarpal bones to the ulnar border of the hand, to form the deep palmar arch. At its termination it inosculates with the deep branch of the ulnar artery. In the forearm this vessel extends from opposite the neck of the radius to the fore part of the styloid process, being placed to the inner side of the shaft of the bone above and in front of it below. It is superficial throughout its entire extent, being covered by the integument, the superficial and deep fasciae, and slightly overlapped above by the supinator longus. In its course downward it lies on the tendon of the biceps, the supinator brevis, the radial origin of the flexor sublimis digitorum. The radial nerve lies on the outer side of the artery in the middle third of its course, and after piercing the deep fascia, runs along the lower part of the artery as it winds around the wrist. The radial artery is accompanied by two veins (not shown on the plate) known as the *venae comites*. In the hand it passes from the upper end of the first interosseous space, between the heads of the adductor indicis or first dorsal interosseous muscle, transversely across the palm, to the base of the metacarpal bone of the little finger, where it inosculates with the communicating branch from the ulnar artery (marked C), forming the deep palmar arch. It lies upon the carpal extremities of the metacarpal bones and the interossei muscles (marked O. P. P.), being covered by the adductor obliquus pollicis, the flexor tendons of the fingers and the flexor brevis digiti. The branches of the radial artery may be divided into three groups corresponding with the three regions in which the vessel is situated as follows: In the forearm the

radial artery gives off the following, radial recurrent, muscular, anterior carpal. At the wrist it gives off the posterior carpal, metacarpal, dorsales pollicis, dorsalis indicis. In the hand the princeps pollicis, radialis indicis, perforating, interosseous, and palmar recurrent.

The ulnar artery (marked C) the larger of the two terminal branches of the brachial, commences a little below the bend of the elbow, and crosses obliquely from the inner side of the forearm to the commencement of its lower half; it then runs along its ulnar border to the wrist, crosses the annular ligament on the radial side of the pisiform bone, and immediately beyond this bone divides into two branches, superficial and deep palmar. In the upper half it is deeply seated, being covered by all the superficial flexor muscles, excepting the flexor carpi ulnaris. It is crossed by the median nerve, which lies just above to its inner side, and it lies upon the brachialis anticus and flexor profundus digitorum muscles. In the lower half of the forearm it lies upon the flexor profundus being covered by the integument, the superficial and deep fascia, and is placed between the flexor carpi ulnaris and flexor sublimis digitorum muscles. It is accompanied by two *venae comites*, or accompanying veins. The ulnar nerve lies on its inner side for the lower two thirds of its extent. At the wrist the ulnar artery is covered by the integument and fascia, and lies upon the anterior annular ligament. On its inner side is the pisiform bone. The ulnar nerve lies at the inner side, and somewhat behind the artery. The branches of the ulnar artery may be arranged in the following manner. In the forearm will be found the anterior ulnar recurrent, posterior ulnar recurrent, anterior and posterior interosseous and muscular arteries. At the wrist are the anterior and posterior carpal arteries, and in the hand are found the superficial palmar arch, and deep palmar or communicating artery.

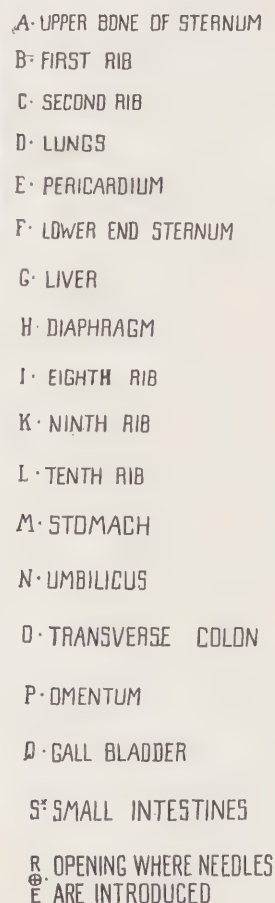
The deep palmar or communicating branch (marked E in middle illustration) passes deeply inward between the adductor minimi digiti and flexor brevis minimi digiti near their origins; it anastomoses with the termination of the radial artery, completing the deep palmar arch. The superficial palmar arch passes outward across the palm of the hand, describing a curve with its convexity forward to the space between the ball of the thumb and the index finger, where the arch is completed by its anastomosing with a branch from the radialis indicis, though sometimes the arch is completed by its an-

astomosing with the superficial volae branch of the radial artery.

The digital branches are four in number, are given off from the convexity of the superficial palmar arch. They supply the ulnar side of the little finger and the adjoining sides of the little, ring, middle, and index fingers, the radial side of the index finger and thumb being supplied from the radial artery. The digital arteries at first lie superficial to the flexor tendons, but as they pass forward with the digital nerves to the clefts between the fingers they lie between them, and are there joined by the interosseous branches from the deep palmar arch. The digital arteries on the sides of the fingers lie behind the digital nerves; and about the middle of the last phalanx the two branches for each finger form an arch, from the convexity of which branches pass to supply the pulp of the finger. The colored diagrams plainly show the various branches as they pass to the ends of the fingers supplying them with preserving solution. If the finger nails are discolored, they must be massaged before any fluid is injected into the arterial system.

This can best be accomplished by holding the hands up so as to facilitate the gravitation of the blood from the hands towards the body, at the same time massaging the surface of the forearm to facilitate the passage of blood through the veins, also toward the body. If the brachial artery is used as a point for injection, the lower portion of the artery should always be injected downwards towards one hand so as to assure a circulation into that hand. If the artery is tied before the injection is made, there may be a lack of fluid in the lower part of the arm and putrefactive changes may result. This is a common occurrence, and often necessitates placing the "good hand upon the bad one" so as to conceal the lack of preservation. We are enabled to reduce the discoloration from the ends of the fingers and under the nails by massage, especially when the blood is in a liquid condition. Otherwise it is necessary to inject the arms downwards with a preparation that turns the blood a pink color thus restoring the finger nails to a natural pink. This preparation does not alter the color of the blood after it has once turned it pink, thereby retaining the natural pink color of the fingers and nails. If the embalming is performed with this preparation, the hands and fingers will present a natural color by the ordinary passage of the fluid to the hands as well as other parts of the body.

ABDOMINAL CAVITIES



This anatomical plate permits the reader to see at a glance the position of the organs and glands contained in the cavities of the chest and abdomen. In the thoracic cavity the lungs are marked (Dx), right lung which has three lobes, and (D) left lung which has two lobes. The heart shown in red is marked (E) and is partially covered by the lobes of the right and left lung. The ribs, which have been cut at their cartilagenous portion, are marked as follows: First rib (B) and (Bx), second ribs (Cx and C), the eighth, ninth and tenth ribs (I. K. L.), upper portion of sternum (A), lower part of omach (M), umbilicus (N), omentum (P), sternum (F), liver (G), gall bladder (Q), st transverse colon under omentum is marked (O), small intestines (S and Sx). On the strip of abdominal wall is indicated the opening where needles are introduced marked (RxE). The diaphragm follows the ribs marked (K and Kx).

Plate No. 17. CONTENTS OF THORACIC AND ABDOMINAL CAVITIES

This colored plate gives the exact position of the organs and glands contained in the thoracic and abdominal cavities, which play such an important part in guiding the embalmer when aspirating their liquid and gaseous contents and injecting preserving solutions. It will be seen that the lungs, which are naked (D and Dx) partially cover the heart, which is marked (E). The stomach, which occupies a position on the left side immediately below the diaphragm and is marked (M) is protected by the last four ribs. The liver, which partially covers the stomach, and which occupies a position on the right side immediately below the diaphragm is marked (G). The large and small intestines are marked (O, Ox and S). The importance of always aspirating liquids and gases from the hollow organs of the abdomen as well as the hollow cavities cannot be overestimated. While many teachers and embalmers never sterilize the cavities or organs, claiming this is an unnecessary performance, the conditions that follow neglect of this important part of the process of modern embalming often manifest themselves in a most astonishing manner. Experience and research work has taught us that these organs and glands play an important part in the digestion of food as well as the elimination of its waste products, and that if these partially digested substances as well as their waste refuse remain undisturbed, gas and discharges will often result, to the dismay of the embalmer. If we are to be sanitary embalmers, it is absolutely necessary to disinfect and preserve the contents of these hollow organs and glands, as well as to sterilize the hollow cavities which contain them. There are so many pathological conditions that are present after death, to say nothing of the pathogenic bacteria that are swarming in these parts, that to neglect this important part of the operation is equivalent to failure. This colored anatomical diagram offers a clear understanding of the parts into which the aspirating and injecting needle must be passed in order to eliminate the gas and liquids as well as the parts that should receive a liberal irrigation of disinfecting and preserving liquid.

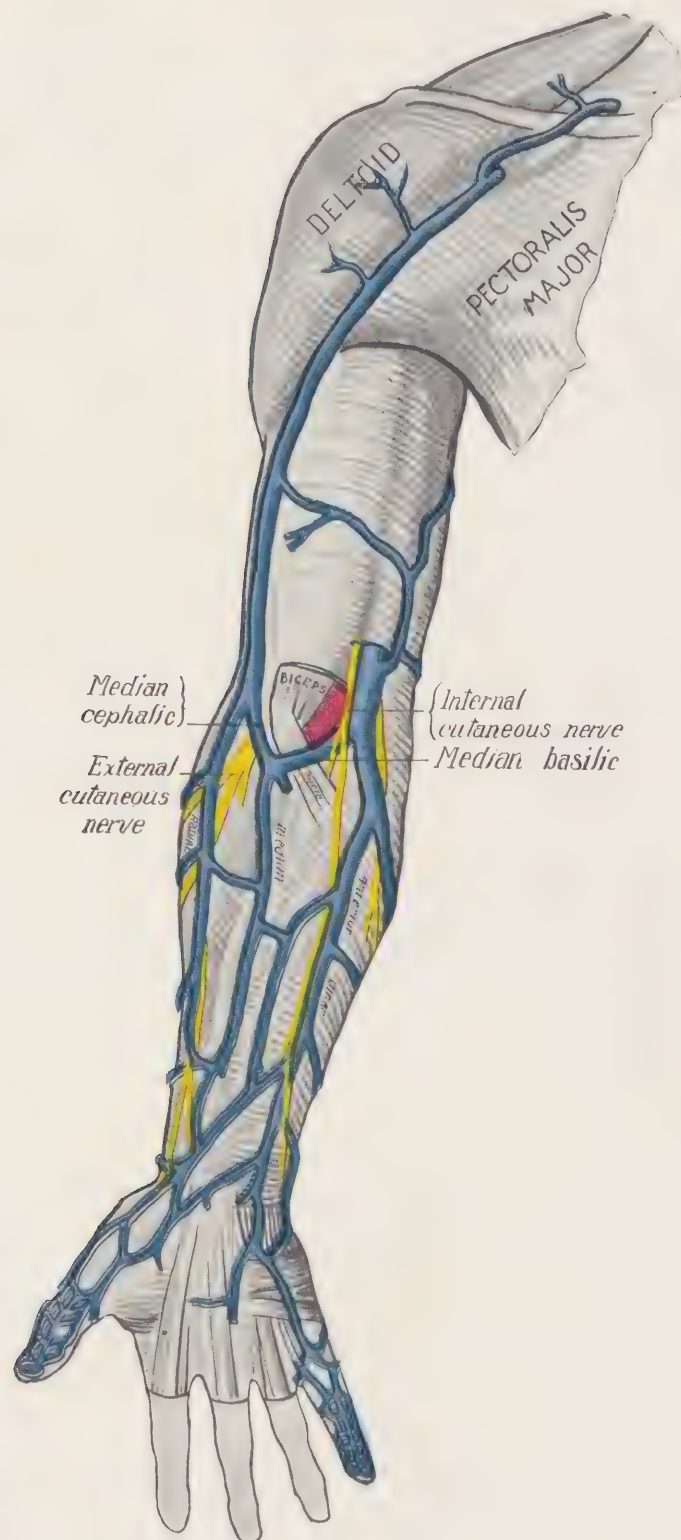
To facilitate a clear understanding of the modern process of cavity preservation, consult the point on the plate marked (Rx E) on the narrow strip of skin that it attached to the lower portion of the sternum marked (F) and extends to the umbilicus which is marked (N). This point will permit the

embalmer to reach all parts of the thoracic and abdominal cavities from a small opening made in the walls of the abdomen at that point. The lungs are usually filled with blood, and if not filled, they always contain some blood which settles in their posterior portions after death. If the pleural cavities are not properly irrigated with preserving solutions, this blood as well as the pleural lining, and in some cases where pathological conditions are present, will afford a suitable medium for the rapid generation of gas, and this gas being unable to escape will force itself upwards through the cellular tissue at the base of the neck, resulting in tissue gas of the neck and muscles of the chest. This is what is generally referred to as tissue gas, and is nature's way of impressing the operator with the fact that this part of the body has been neglected by him.

The stomach, which is marked (M) is always the recipient of food and drink, and after death has taken place, this partially digested food and liquid undergoes rapid fermentation under the thermal conditions that always prevail in the body after death, and before it has had time to cool to the same temperature of the surrounding atmosphere. If the day is hot, the radiation will take place much slower than during the cold weather. It is usually during the hot months that the most trouble is experienced by the embalmer who neglects this most important part of his work. The contents of the stomach undergoing rapid fermentation will, under pressure of the gas generated, force the liquid contents of the stomach up through the oesophagus and it will escape through the corners of the mouth, and sometimes through the nostrils also. The large and small intestines marked (Ox, O, and S, Sx), always contain faecal matter as well as legions of ferments which become very active after death. These agencies cause a rapid evolution of gas in this long hollow canal, which distends it to its utmost limits, thereby distending the muscles of the abdomen to their greatest extent. When the pressure has assumed great proportions, the walls of the abdomen will not permit of greater distention, and the pressure exerted upon the lower portion of the stomach, (which can be easily seen by consulting the plate) will also facilitate the expulsion of its liquid contents through the oesophagus causing what is usually termed "purging." To facilitate the aspiration of gas and liquids from the hollow organs as well as the cavities, the Renouard aspirating needle is em-

ployed. This needle is provided with a sharp point to permit of its penetration into the various cavities as well as into the hollow organs and glands, and with the aspirating pump their gaseous and liquid contents are removed through the many perforations which the needle is provided with. The needle is introduced through a small opening made in the walls of the abdomen at the point between the end of the sternum and navel, (marked Rx E) and passed into the right and left pleural cavities, the cardiac sac, the stomach, intestines at various points—so as to perforate all parts, the urinary bladder and pelvic cavity. After the process of aspiration has been completed, the needle is passed through the same opening and the above mentioned parts are injected with a liberal quantity of preserving and disinfecting liquid. In this manner the solids which cannot be removed with the aspirating needle, are preserved and disinfected, thereby preventing the generation of more gas. Care should be exercised not to injure any of the large arterial branches, thereby causing a hemorrhage of fluid and blood from the opening in the abdomen through which the needle was passed. This often happens when the cavity work is not scientifically performed, thereby necessitating the sewing up of the opening made in the abdomen. Regardless of the strength of the preserving solution employed, gas may again generate in these parts, and its removal becomes necessary, and a fresh supply of fluid must be injected. This second injection is often necessary to overcome the formation of gases, and continue the function of preservation where the fluid first injected was overwhelmed by the conditions existing when the first injection was made. Do not blame the fluid if you are responsible for improperly distributing it. Putrefaction always manifests itself in those parts where the preserving agents do not come into immediate contact with the parts to be preserved. The colored illustration and the description of the sterilization and preservation must impress upon the reader the necessity for a thorough training and a complete understanding of the technique of modern embalming as demonstrated in modern schools of embalming. This part of the embalmer's training is of the utmost importance if success is to be attained in all cases. The time is not far distant when this part of the process of modern embalming will be insisted upon by the various health authorities in all cases, regardless of the cause of death.

Plate No. 18. SUPERFICIAL VEINS OF THE ARM



This chart illustrates the superficial veins of the arm, and conveys a clear idea of the course and formation of the larger branches. The superficial veins of the forearm are the anterior ulnar, median, and radial. These unite a little below the elbow to form the median basilic and median cephalic veins. The most important of these branches is the basilic, which we use when introducing the improved blood tube for removing blood from the right auricle of the heart. The internal cutaneous nerve, which is printed in yellow, follows the basilic vein on its inner border.

Plate No. 18. SUPERFICIAL VEINS OF THE ARM

This colored plate illustrates the superficial veins of the arm, and conveys a clear idea of the course and formation of the larger branches. The superficial veins of the forearm are the anterior ulnar, median, and radial. These unite a little below the elbow to form the median basilic and median cephalic veins. The most important of these branches is the basilic which we use when introducing the improved blood tube for removing blood from the right auricle of the heart. The internal cutaneous nerve (printed in yellow) follows the inner border of the basilic vein.

The veins of the arm are divided into two sets, superficial and deep seated. The superficial veins are located immediately beneath the integument between the two layers of superficial fascia. The deep veins accompany the arteries, and constitute the *venae comites* of those vessels. Both sets of vessels are provided with valves, which are more numerous in the deep than in the superficial.

The superficial veins of the arm are as follows: Superficial veins of the hand, anterior ulnar, posterior ulnar, common ulnar, radial, median, median basilic, median cephalic, basilic and cephalic.

The superficial veins of the hand and fingers are principally situated on the dorsal surface and form two plexuses, an inner and outer, on the back of the hand. The inner plexus is formed by the veins from the little finger, the ring finger and the ulnar side of the middle finger; from it the anterior and posterior ulnar veins are derived. The outer plexus is formed by veins from the thumb, the index finger, the radial side of the middle finger; from it the radial vein is formed. These two plexuses communicate on the back of the hand, forming the superficial arch of veins in this situation. The superficial veins from the palm of the hand form a plexus in front of the wrist, from which the median vein is derived.

The anterior ulnar vein commences on the anterior surface of the ulnar side of the hand and wrist, and ascends along the anterior surface of the ulnar side of the forearm to the bend of the elbow, where it joins with the posterior ulnar vein to form the common ulnar vein. Occasionally it opens separately into the median basilic vein. It communicates with branches of the median vein in front and with the posterior ulnar behind.

The posterior ulnar vein commences on the posterior surface of the ulnar side of the wrist. It runs on the posterior surface of the ulnar side of the forearm, and just below the elbow unites with the anterior ulnar vein to form the common ulnar, or

else joins the median basilic to form the basilic. It communicates with the deep veins of the palm by a branch which emerges from beneath the adductor digital muscle.

The common ulnar is a short trunk which is not consistent. When it exists it is formed by the junction of the two preceding veins and passing upward and outward, joins the median basilic to form the basilic vein. When it does not exist the anterior and posterior ulnar veins open separately into the median basilic vein.

The radial vein commences from the dorsal surface of the wrist, communicating with the deep veins of the palm by a branch which passes through the first interosseous space. It forms a large vessel, which ascends along the radial side of the forearm and receives numerous veins from both of its surfaces. At the bend of the elbow it unites with the median cephalic to form the cephalic vein.

The median vein ascends on the front of the forearm, and communicates with the anterior ulnar and radial veins. At the bend of the elbow it receives a branch of communication from the deep veins and divides into two branches, the median cephalic and median basilic, which diverge from each other as they ascend. This can be plainly seen by consulting the colored anatomical plate supplementing the article. The median cephalic vein, usually the smaller of the two, passes outward in the groove between the supinator longus and biceps muscles, and joins with the radial to form the cephalic vein. The branches of the external cutaneous nerve can be seen passing under this vessel.

The median basilic vein passes obliquely inward, in the groove between the biceps and pronator radii teres, and joins the common ulnar to form the basilic. This vein can be seen passing in front of the brachial artery, from which it is separated by a fibrous expansion (the bicipital fascia), which is given off from the tendon of the biceps to the fascia covering the flexor muscles of the forearm. Filaments of the internal cutaneous nerve pass in front as well as behind this vessel.

The basilic vein, which is usually used for the removal of blood from the right auricle of the heart by passing the improved blood tube upwards through the axillary, subclavian, innominate and superior vena cava, is of considerable size, formed by the coalescence of the common ulnar vein with the median basilic. It passes upward along the inner side of the biceps muscle, pierces the deep fascia a little below the middle of the arm and, ascending in the course of the brachial artery, terminates in the axillary

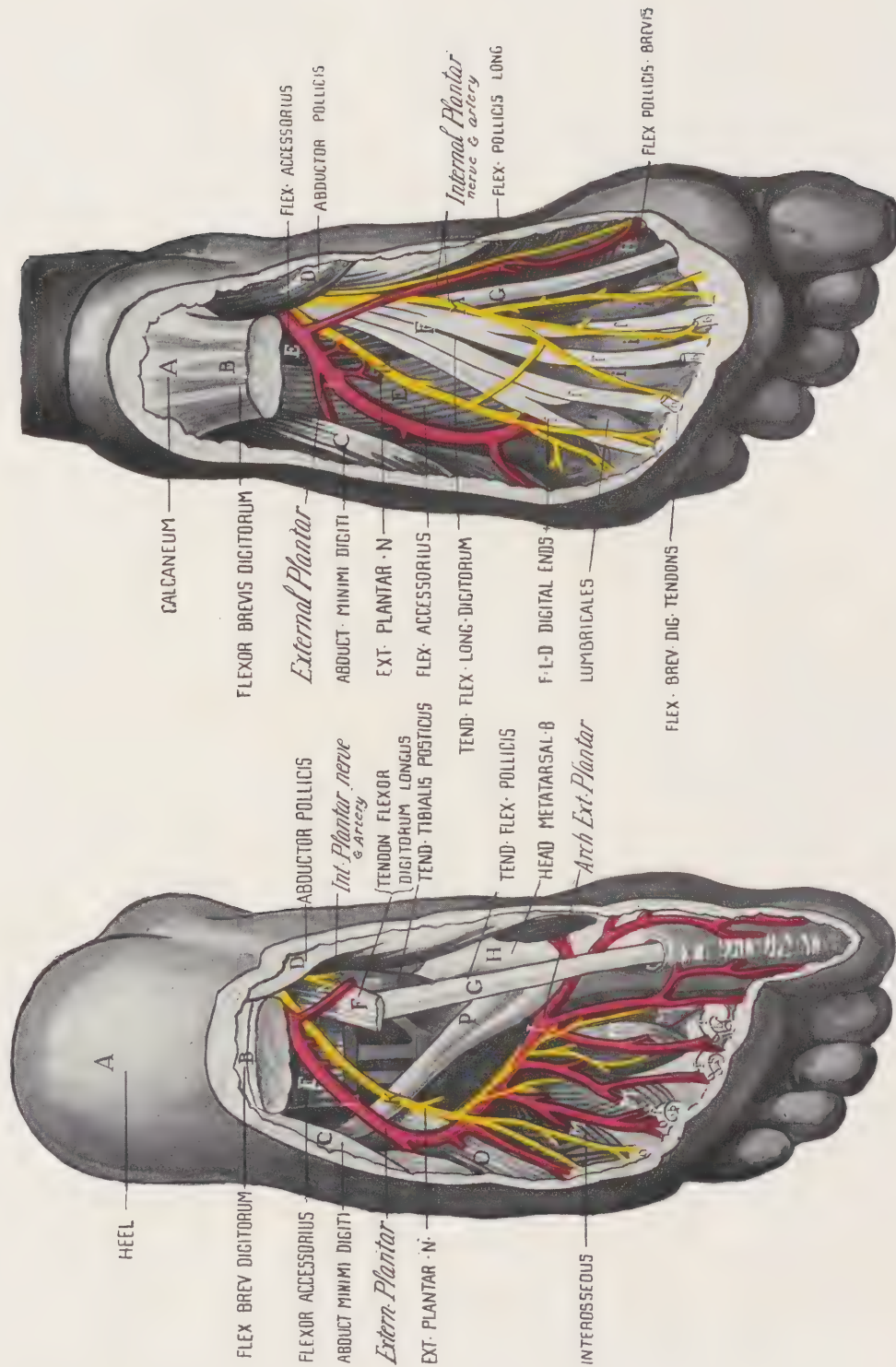
vein, which receives, a little higher up, the brachial *venae comites*.

The cephalic vein which courses along the outer border of the biceps muscle, lying in the same groove with the upper external cutaneous branch of the musculo-spiral nerve, to the upper third of the arm; it then passes into the interval between the pectoralis major and deltoid muscles, lying in the same groove with the descending branch of the acromial thoracic artery. It pierces the costo-coracoid membrane, and terminates in the axillary vein just below the clavicle. This vein is occasionally connected with the external jugular vein, or sub-clavian, by a branch which passes from it upward in front of the clavicle.

By making a survey of the colored plate the reader will be enabled to see at a glance the situation of these important branches. It will be noticed that the plexus of veins are distinctly seen in the anatomical chart, on the thumb and little finger and this will afford an opportunity of seeing just how discoloration of the ends of the fingers is produced. The fact that we now have discovered new preparations that impart a pink color to the blood, enables us to change the discolored ends of the fingers to a natural pink color. The proper technique, regardless of the preserving solution employed, is to first raise the hands above the head and by massaging the ends of the fingers, press the blood from the plexus of veins at the ends of the fingers. After the blood has been dislodged, it will naturally gravitate into the larger branches which can be plainly seen on the forearm, thence the blood gravitates into the median basilic and median cephalic veins and into the basilic and cephalic veins and whence it passes into the axillary vein, where the blood tube had been passed, thereby facilitating the removal of blood from the lower portion of the arm and hands.

Fluid should never be injected before the blood is removed from the finger tips by massaging, otherwise the action of the fluid may coagulate the blood thereby fixing the discoloration to such an extent that its removal will be rendered impossible. Another reason for removing the blood from the ends of the fingers before the fluid is injected is the action of formaldehyde upon the hemoglobin of the blood which imparts a leaden blue color to it, thereby giving the ends of the fingers and sometimes the hands a very dark leaden color. The use of the improved blood tube which is passed into the basilic vein is so simple that any person can easily pass it into the right auricle of the heart which is the termination of the large veins from the upper and lower parts of the body.

Plate No. 19. THE PLANTAR ARCH



The above illustrations show the internal and external plantar arteries as well as the plantar arch. The red lines indicate the arteries and the yellow the nerves. The illustrations show the dissection of the bottom of the foot, exposing nerves, arteries and muscles. There is a close similarity between the plantar arch of the foot and the palmar arch in the hand. The heel is marked (A). The tendon flexor pollicis is marked (G). External plantar nerve is marked (K). Flexor brevis digitorum is marked (B). In the illustration on the left is seen the digital arteries supplying the toes.

Plate No. 19. THE PLANTAR ARCH

This colored plate illustrates the arterial branches that convey preserving liquids to the internal and external parts of the feet. The illustrations show that dissection of the bottom of the feet, exposing arteries, nerves, muscles and tendons. There exists a close similarity between the plantar and palmar arches.

The plate is lettered in such a manner that the various arteries, nerves, muscles and tendons can be easily found. The heel is marked with the letter (A). The flexor brevis digitorum is marked (B). The tendon flexor pollicis is marked (G). External plantar nerve is marked (K).

A brief description of the arteries illustrated in the colored plates will aid the reader in more fully understanding their course and the parts they supply.

The internal plantar artery is much smaller than the external and passes forward along the inner side of the foot. It is at first situated above the abductor hallucis, and then between it and the flexor brevis digitorum, both of which it supplies. At the base of the first metatarsal bone, where it has become much diminished in size, it passes along the inner border of the great toe, inosculating with its digital branch.

The external plantar artery much larger than the internal, passes obliquely outward and forward to the base of the fifth metatarsal bone. It then turns obliquely inward to the interval between the bases of the first and second metatarsal bones, where it communicates with the plantar digital branch from the dorsalis pedis artery, thus completing the plantar arch. As this artery passes outward, it is first placed between the os calcis and abductor hallucis, and then between the flexor brevis digitorum and flexor accessorius, and as it passes forward to the base of the little toe, it lies more superficially between the flexor brevis digitorum and abductor minimi digiti, covered by the deep fascia and integument. The remaining portion of the vessel is deeply situated and extends from the base of the metatarsal bone of the little toe to the back part of the first interosseous space, and forms the plantar arch; it is convex forward, lies upon the interossei muscles opposite the tarsal ends of the metatarsal bones and is covered by the abductor obliquus hallucis, the flexor tendons of the toes and the small muscles of the foot.

The digital branches are four in number, and supply the three outer toes and half of the second toe. The first passes outward from the outer side of the plantar arch,

and is distributed to the outer side of the little toe, passing in its course beneath the abductor and short flexor muscles. The second, third, and fourth run forward along the interosseous spaces, and on arriving at the clefts between the toes divide into collateral branches, which supply the adjacent sides of the three outer toes and the outer side of the second. At the bifurcation of the toes each digital artery sends upward, through the fore part of the corresponding interosseous space a small branch which inosculates with the interosseous branches of the metatarsal artery. These are the anterior perforating branches. The above mentioned branches can be easily traced on the illustration on the left.

From the arrangement already described of the distribution of the vessels to the toes it will be seen that both sides of the three outer toes and the outer side of the second toe are supplied by branches from the plantar arch; both sides of the great toe and the inner side of the second are supplied by the plantar digital branches of the dorsalis pedis. The above described branches are printed in red so they may be easily traced on the chart.

The veins are not illustrated, but there are many, both superficial and deep seated, and these play a very important part in connection with the plantar arch in cases of obstruction of the arteries and veins which produce irregularities in the circulation, and of hemorrhages. This obstruction may arise in various ways, from without by ligature or compression; from within by thrombosis. By this term is meant the formation of a coagulum or blood clot within the vessel during life. This coagulation occurs for the most part when the circulation is weakened or arrested, and the vessel walls are diseased. The consequences are various. Often the tissues concerned are slightly affected, in other cases they may undergo anaemic necrosis. If the circulation is brought to a standstill the region beyond the block becomes anaemic. If the arterial twigs of this region are connected directly with some other unobstructed artery, the latter forthwith dilates and conveys the blood in sufficient quantities to irrigate the impoverished region. The circulation is thus speedily re-established. If however, the vessels of the region possess no such collateral connections, the region itself is altogether deprived of blood, and sooner or later perishes.

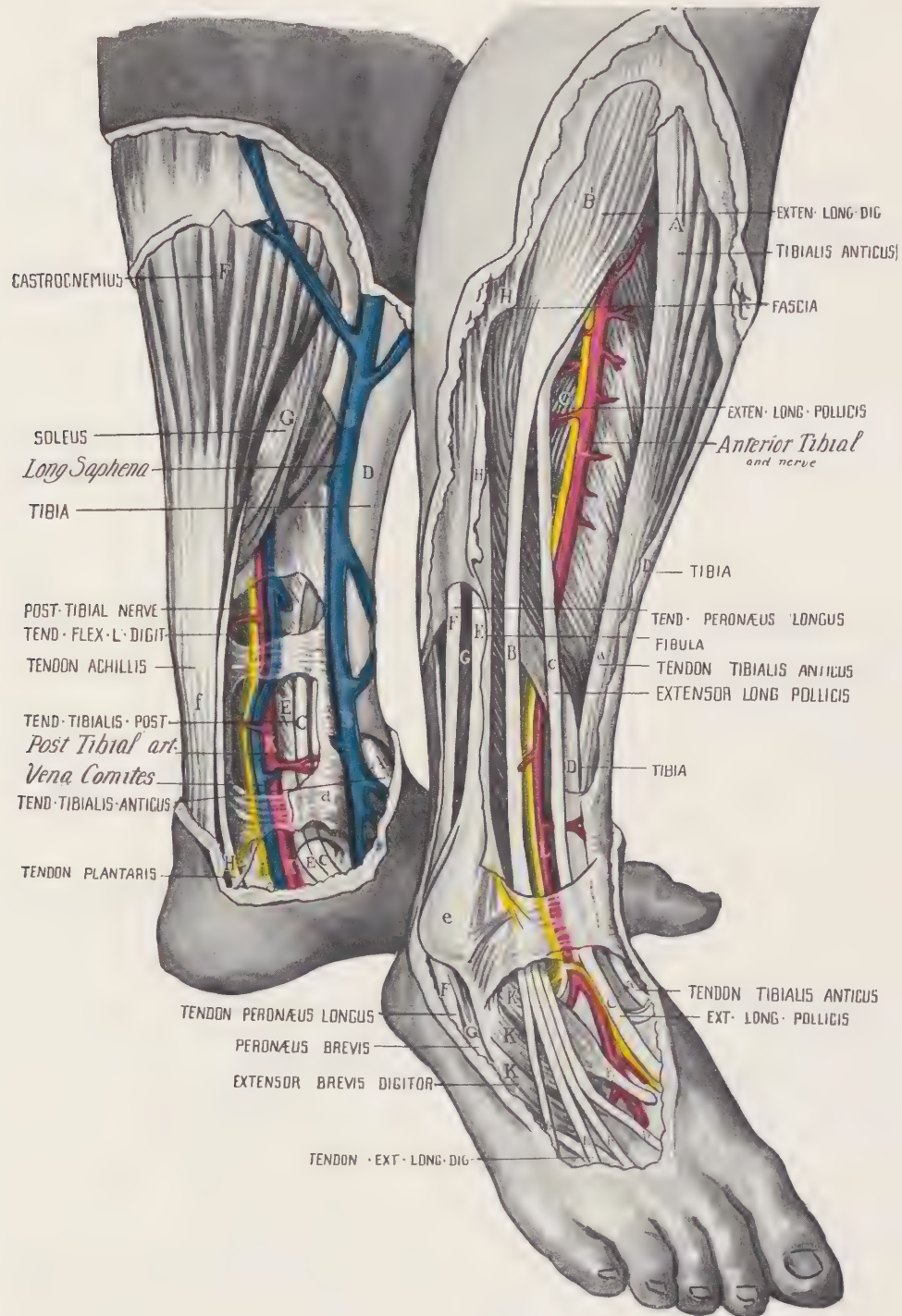
If the embolized artery be a terminal artery, having no arterial anastomosis, a scanty influx of blood to the tissues from

the adjacent veins and capillaries may still be possible. The capillaries of the anaemic region become gradually filled with blood, partly derived from the capillaries of neighboring regions, partly from slow reflux out of the veins. The blood oozing in from the neighboring capillaries is under a very low pressure. This pressure is insufficient to propel the blood out of the obstructed capillary system into the corresponding veins again. The blood therefore stagnates, and the capillaries become even more and more engorged. Of course, whatever reflux takes place from the veins can only carry blood into the capillaries, it cannot suffice to drive the blood through the capillaries.

The injuries which lead to local death and are most common in that part of the body in which the plantar arch is located may be divisible into three groups. The first includes those which destroy the tissue by their mechanical or chemical action. Thus external violence may crush a toe or the foot, acid may destroy a patch of skin, and fungus parasites may disorganize the structure of a gland in which they are permitted to grow. A second group of injuries may be classed as thermal. If the temperature of a tissue is maintained at 54 deg. C. to 58 deg. C. for any time the tissue is inevitably killed. High temperatures act still more rapidly. A third cause of necrosis is arrest of nutrition. This produces anaemic necrosis, and occurs frequently in the human body. All causes which seriously interfere with the circulation of a part, and bring about permanent arrest of its movement, or stasis, may lead to the death of the affected tissue. Such causes are thrombosis, embolism, closure of the vessels by disease or ligature, pressure on the tissue, inflammation and hemorrhage.

A constant result of the death of a portion of tissue is more or less severe inflammation in the surrounding portions. This is most severe when decomposition takes place in the dead portion, which turns black and gives off a pronounced odor which can be treated with crisin full strength, or any other product that will harden and dry up the parts. The injection of the arteries in this instance would prove of no avail due to the interrupted circulation, or rather lack of circulation in the immediate part; hence the external application of a preparation that will harden the tissue as well as instantly destroy the odor of putrefaction, which is always present. This may apply equally to any part of the body where necrosis has taken place, but in this instance it applies to either of the feet in the vicinity of the plantar arch.

Plate No. 20.
ANTERIOR AND POSTERIOR TIBIAL ARTERIES



This colored anatomical diagram shows the large arteries that supply the lower part of the leg and eventually form the plantar arch. Anterior tibial artery is marked (L), posterior tibial artery is marked (K), long saphena vein is marked (B), the accompanying veins are marked (I), tendon achillis is marked (F). The relative position of the anterior and posterior tibial arteries and accompanying veins are clearly illustrated in the above diagrams. The position of the muscles, tendons and nerves are drawn in such a manner as to expose the course of the arteries and veins of the lower leg.

Plate No. 20.

ANTERIOR AND POSTERIOR TIBIAL ARTERIES

This colored plate shows the large arteries that supply the lower part of the leg and eventually form the plantar arch. In order to show the fascia muscles, tendons and nerves, the chart illustrates the leg, as if dissected. The arteries are printed in red, while the veins are printed in blue and the nerves in yellow. The anterior tibial artery is marked (L); long saphena vein is marked (B); tendon achillis is marked (F); tibia is marked (D).

The position of the anterior and posterior tibial arteries and their branches, as well as the veins, are clearly exposed by the manner in which the tendons, muscles and nerves are drawn on the two illustrations. The anterior tibial artery commences at the bifurcation of the popliteal at the lower border of the popliteus muscle, passes forward between the two heads of the tibialis posticus, and through the large oval aperture above the upper border of the interosseous membrane to the deep part of the front of the leg; it then descends on the anterior surface of the interosseous membrane, gradually approaching the tibia and, at the lower part of the leg, lies on this bone, and then on the anterior ligament of the ankle to the bend of the ankle joint, where it lies more superficially, and becomes the *dorsalis pedis*.

In the upper two-thirds of its course it rests upon the interosseous membrane to which it is connected by delicate fibrous arches thrown across it; in the lower third, upon the front of the tibia and the anterior ligament of the ankle joint. In the upper third of its course it lies between the tibialis anticus and *extensor longus digitorum*; in the middle third, between the tibialis anticus and *extensor proprius hallucis*. At the bend of the ankle it is crossed by the tendon of the *extensor proprius hallucis*, and lies between it and the innermost tendon of the *extensor longus digitorum*. It is covered, in the upper two-thirds of its course, by the muscles which lie on either side of it and by the deep fascia; in the lower third, by the integument anterior annular ligament, and fascia. The anterior tibial artery is accompanied by two veins (*venae comites*) which are not shown in the illustration, which lie one on each side of the artery.

The branches of the anterior tibial artery are, posterior recurrent tibial, superior fib-

ular, anterior recurrent tibial, muscular, internal malleolar, external malleolar.

The posterior recurrent tibial artery is not a constant branch. It is given off from the anterior tibial before that vessel passes through the interosseous space. It ascends beneath the popliteus muscle, which it supplies, and anastomoses with the lower articular branches of the popliteal artery, giving off an offset to the superior tibio fibular joint. The superior fibular is sometimes given off from the anterior tibial, sometimes from the posterior tibial. It passes outward, round the neck of the fibula, through the soleus, which it supplies, and ends in the substance of the *peroneus longus* muscle. The anterior recurrent tibial branch arises from the anterior tibial as soon as that vessel has passed through the interosseous space; it ascends in the tibialis anticus muscle, and ramifies on the front and sides of the knee joint, anastomosing with the articular branches of the popliteal and with the *anastomotica magna*. The muscular branches are numerous, as can be seen on the plate, and are distributed to the muscles which lie on each side of the vessel, some piercing the deep fascia to supply the integument, others passing through the interosseous membrane and anastomosing with branches of the posterior tibial and peroneal arteries.

The malleolar arteries supply the ankle joint. The internal arises about two inches above the articulation, and passes beneath the tendons of the *extensor proprius hallucis* and tibialis anticus to the inner ankle, upon which it ramifies, anastomosing with branches of the posterior tibial and internal plantar arteries. The external passes beneath the tendons of the *extensor longus digitorum* and *peroneus tertius*, and supplies the outer ankle, anastomosing with the anterior peroneal artery and with ascending branches from the tarsal branch of the *dorsalis pedis* artery.

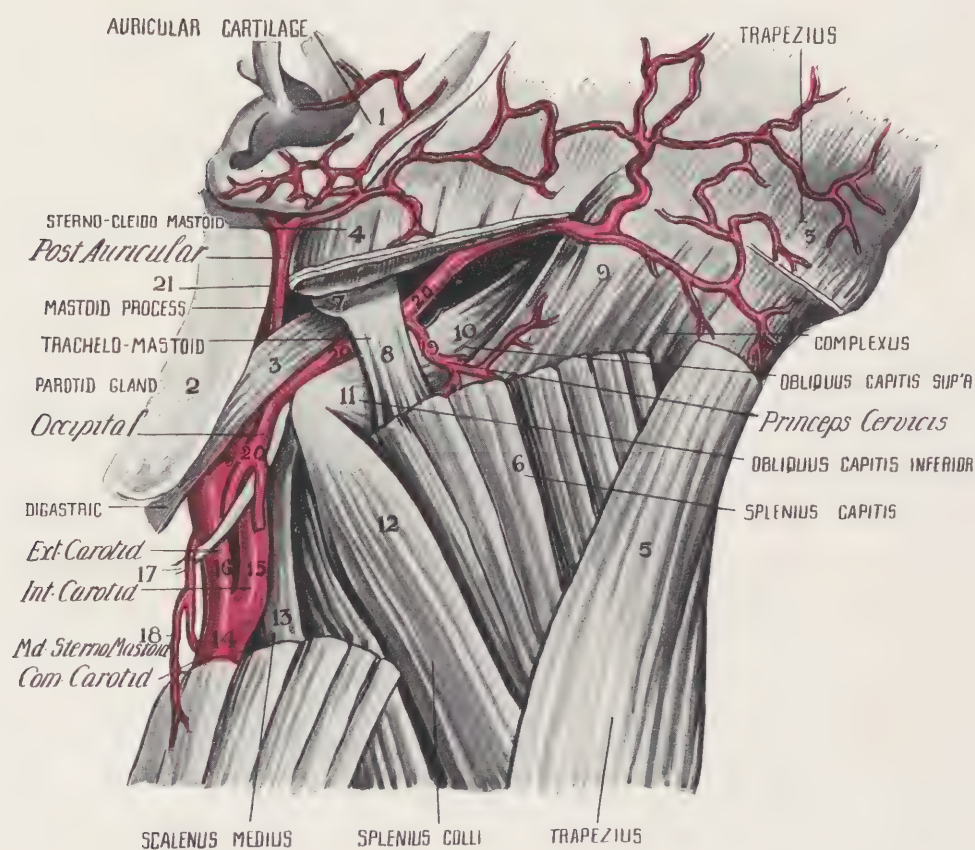
The *dorsalis pedis* artery, the continuation of the anterior tibial, passes forward from the bend of the ankle along the tibial side of the foot to the back part of the first intermetatarsal space, where it divides into two branches, the *dorsalis hallucis*, and the communicating, or first dorsal interosseous

artery and plantar digital respectively. The vessel, in its course forward, rests upon the astragalus, navicular, and internal cuneiform bones and the ligaments connecting them, being covered by the integument and fascia, anterior annular ligament, and crossed near its termination by the innermost tendon of the *extensor brevis digitorum*. On its tibial side is the tendon of the *extensor proprius hallucis*; on its fibular side, the innermost tendon of the *extensor longus digitorum*, and the termination of the anterior tibial nerve. It is also accompanied by two veins which are not shown on the colored supplement.

The posterior tibial artery is of large size, which extends obliquely downward from the lower border of the popliteus muscle, along the tibial side of the leg, to the fossa between the inner ankle and the heel, where it is divided beneath the origin of the *abductor hallucis*, on a level with a line drawn from the point of the internal malleolus to the center of the convexity of the heel, into the internal and external plantar arteries. At its origin it lies opposite the interval between the tibia and fibula; as it descends, it approaches the inner side of the leg, lying behind the tibia, and, in the lower part of its course, is situated midway between the inner malleolus and the tuberosity of the os calcis. This artery is also accompanied by the two *venae comites* which are plainly seen in the colored chart. The branches of the posterior tibial artery are the peroneal, muscular, nutrient and communicating.

The peroneal artery lies deeply seated along the back part of the fibular side of the leg. It arises from the posterior tibial about an inch below the lower border of the popliteus muscle, passes obliquely outward to the fibula, and then descends along the inner border of that bone to the lower third of the leg, where it gives off the anterior peroneal. It then passes as the posterior peroneal, across the articulation between the tibia and fibula to the outer side of the os calcis, where it gives off its terminal branches, the external calcanean. These smaller branches are not shown, but were described and shown in the previous plates.

Plate No. 21. EXTERNAL CAROTID ARTERY AND THE TWO IMPORTANT BRANCHES



The above illustration shows the external and internal carotid arteries, as well as two of the important branches given off by the external carotid. The illustration shows a dissection of the neck and lower posterior portion of the cranium. The red lines illustrate the course of the arterial branches. The internal carotid is marked (16), the external carotid is marked (15), the occipital artery is marked (20), while the posterior auricular artery is seen supplying the lower lobe of the ear.

Plate No. 21. EXTERNAL CAROTID ARTERY AND THE TWO IMPORTANT BRANCHES

This colored plate of the neck and lower posterior portion of the skull will be found to be of great value to the embalmer. These branches, which are numbered so they can be easily traced on the colored illustrated supplement, give a clear idea of the passage of the preserving fluid to the parts in question. The internal carotid artery (marked 15), external carotid artery (marked 16), occipital artery (marked 20), common carotid artery (marked 14), sterno cleido mastoid muscle, which has been severed to enable the reader to clearly trace the course of the occipital artery (marked 4). The muscles of the neck which have been severed so as to expose the arterial branches, are as follows: Trapezius (marked 15), splenius capitis (marked 6), splenius colli (marked 12), scalenus medius (marked 13).

To more fully appreciate the colored illustration, it may be well to first give a brief description of the branches illustrated in the colored plate.

The common carotid arteries resemble each other so closely that one description will apply to both. Each vessel passes obliquely upward from behind the sterno clavicular articulation to a level with the upper border of the thyroid cartilage, where it divides into the external and internal carotid, these names being derived from the distribution of the arteries to the external parts of the face and head and to the internal parts of the cranium and orbit. The common carotid artery is contained in a sheath derived from the deep cervical fascia, which also encloses the internal jugular vein, not illustrated on the colored supplement. At the lower part of the neck the common carotid artery is deeply seated, being covered by the integument, superficial fascia, sterno-mastoid, sterno-hyoid and sterno-thyroid muscles, but in the upper part of its course, near its termination, it is more superficial, being covered merely by the integument, the superficial fascia, deep cervical fascia, and inner margin of the sterno-mastoid muscle, and is contained in a triangular space.

The internal carotid artery supplies the anterior part of the brain, the eye, and its appendages, and sends branches to the forehead and nose. Its size in the adult is equal to that of the external carotid, though in the child it is larger than that vessel.

The external carotid artery, as illustrated in the colored supplement and marked 16, commences opposite the upper border of the thyroid cartilage, and passes upward and forward, and then inclines backward to the space between the neck of the condyle of the lower jaw and the external meatus, where it divides into the superficial temporal and internal maxillary arteries. It rapidly diminishes in size in its course up the neck, owing to the number and larger size of the branches which it gives off. In the child it is somewhat smaller than the internal carotid, but in the adult the two vessels are of nearly equal size. At its commencement this artery is more superficial, and placed nearer the middle line than the internal carotid. The external carotid artery gives off eight branches. These shown on the colored supplement are the occipital and posterior auricular arteries. The accompanying anatomical plate shows the lower por-

tion of the ear and muscles attached to the lower part of the skull as well as the distribution of the arterial branches of the occipital and posterior auricular arteries.

The posterior auricular artery is a small vessel which arises from the external carotid artery, opposite the apex of the styloid process. It ascends, under cover of the parotid gland, to the groove between the cartilage of the ear and the mastoid process, immediately above which it divides into two branches, an anterior auricular, passing forward to supply the back of the auricle and anastomose with the posterior division of the temporal and a posterior, mastoid, to the scalp above and behind the ear communicating with the occipital. Besides several small branches to the digastric, stylo-hyoid, and sterno-mastoid muscles and to the parotid gland, this vessel gives off three branches which are illustrated on the colored plate: Stylo-mastoid, auricular, and mastoid.

The stylo-mastoid branch enters the stylo-mastoid foramen, and supplies the tympanum, mastoid cells, and semi-circular canals. In the young subject a branch from this vessel forms, with the tympanic branch from the internal maxillary, a vascular circle, which surrounds the auditory meatus, and from which delicate vessels ramify. It anastomoses with the petrosal branch of the middle meningeal artery by a twig which enters the hiatus fallopii.

The auricular branch is distributed to the back part of the cartilage of the ear, upon which it ramifies minutely, some branches curving around the margin of the fibre cartilage, others perforating it, to supply its anterior surface. It anastomoses with the anterior auricular branches of the temporal. The mastoid branch passes backward, over the sterno-mastoid muscle, to the scalp above and behind the ear. It supplies the posterior belly of the occipito frontalis muscle and the scalp in this portion. It anastomoses with the occipital artery.

The occipital artery arises from the posterior part of the external carotid, opposite the facial and near the lower margin of the digastric muscle. At its origin it is covered by the posterior belly of the digastric and stylo-hyoid muscles, and the hypoglossal nerve winds around it from behind forward; higher up it passes across the internal carotid artery, the internal jugular vein, and the pneumogastric and spinal accessory nerves. It then ascends to the interval between the transverse process of the atlas and the mastoid process of the temporal bone, and passes horizontally backward, grooving the surface of the latter bone, being covered by the sterno-mastoid, splenius, trachelo-mastoid, and digastric muscles, and resting upon the rectus lateralis the superior oblique, and complexus muscles. It then changes its course and passes vertically upward, pierces the fascia which connects the cranial attachment of the trapezius with the sterno-mastoid, and ascends in a tortuous course over the occiput, as high as the vertex, where it divides into numerous branches. It is accompanied in the latter part of its course by the great occipital and a cutaneous filament from the suboccipital nerve. The branches given off from this vessel are, muscular, sterno-mastoid, auricular, meningeal and princeps cervicis. The muscular branch-

es supply the digastric, stylo-hyoid, splenius and trachelo-mastoid muscles. The sterno-mastoid is a large and constant branch, generally arising from the artery close to its commencement. It first passes upward and backward, and then turns downward over the hypo-glossal nerve, and enters the substance of the muscle, frequently in company with the spinal accessory nerve. The auricular branch supplies the back part of the concha. It frequently gives off a branch which enters the skull through the mastoid foramen and supplies the dura mater.

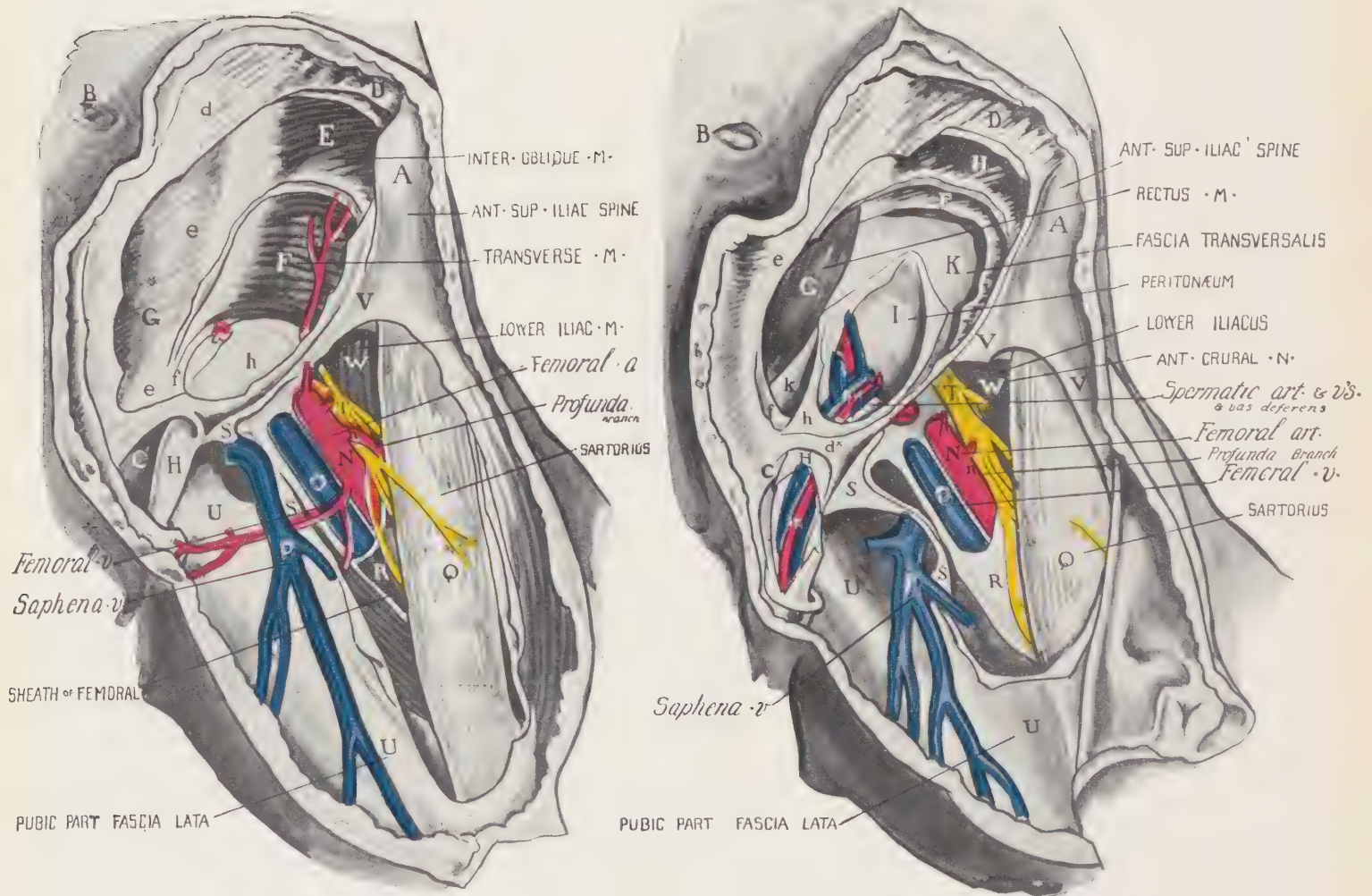
The meningeal branch ascends with the internal jugular vein, and enters the skull through the foramen lacerum posterius, to supply the dura mater in the posterior fossa.

The arteria princeps cervicis is a large branch which descends along the back part of the neck and divides into a superficial and deep branch. The former runs beneath the splenius, giving off branches which perforate that muscle to supply the trapezius which anastomose with the superficial cervical artery, a branch of the transversalis colli, the latter passes beneath the complexus between it and the semi-spinalis colli, and anastomoses with branches from the vertebral and with the deep cervical artery, a branch of the superior intercostal. The anastomosis between these vessels serves mainly to establish the collateral circulation after ligation of the carotid or sub-clavian artery.

The colored plate clearly shows the manner in which the fluid finds its way into the lobe of the ear, also how the fluid may be carried to the posterior of the scalp when the head is opened for medical examination. When the brain is removed for examination, the scalp is cut beginning just above the ear and extending over the middle of the vertex to the corresponding point above the ear on the opposite side. The hair should be parted along the line where the incision is to be made, and the scalp cut away from the cranium. The illustration will clearly show how the fluid will pass through these branches after the operation of removing the brain and cutting the scalp has been performed. It is easily seen that even when the scalp is cut from above the ear, as when the brain is removed, there will be no injury to the posterior auricular or occipital arteries, and the fluid injected into them will supply the parts as thoroughly as if there had been no incision made in the scalp. These arteries serve to supply the ear and the posterior portion of part of the scalp on either side of the head. There may be some leakage from the smaller branches that come in the line of the incision, but the leakage will only be temporary as the fluid will close up the small ends of the arteries and the irrigation of the parts with fluid will be accomplished. The passage of the preserving fluid into the posterior auricular artery will assist in the removal of discoloration by changing the color of the blood to a bright pink, and in conjunction with massage of the ear will restore it to a natural color.

Science has brought to our assistance chemicals that will act upon the blood and change its color to a light pink color thereby imparting a natural color to the tissues that may be discolored by the presence of blood in the capillaries.

Plate No. 22. UPPER PART OF THIGH—ARTERIES, VEINS AND MUSCLES



The above colored supplements portray the muscles, tissues, arteries and veins of the lower portion of the abdomen, and upper portion of the thigh. The peritoneal lining of the abdomen is marked (I), the deep fascia marked (K), Crural nerve in yellow, marked (T), femoral artery marked (N), profunda artery marked (n), femoral vein marked (O), Sartorius muscle marked (Q), adductor longus muscle marked (U), large saphena vein marked (P).

Plate No. 22. UPPER PART OF THIGH—ARTERIES, VEINS AND MUSCLES

This colored plate of the upper part of thigh showing arteries, vein and muscles, is of much importance to the embalmer. These vessels and their branches are lettered so they may be easily traced, thereby giving the reader a complete survey of the part in question.

The anterior superior iliac spine is shown (marked A), umbilicus (marked B), abdominal muscles (marked D, E and F), peritoneum (marked I), transversalis fascia (marked K), femoral artery (marked N), femoral vein (marked O), Saphena vein (marked P), Sartorius muscles (marked Q), sheath of femoral artery and vein (marked R), fascia (marked S), crural nerve (marked S U and V).

The blood vessels and nerve are seen passing under Poupart's ligament in the upper portion of Scarpa's triangle, the lower portions of which are bounded on the outside by the sartorius and adductor on the inner side.

Spermatic artery and veins (marked M), the various branches of the saphena vein which drain the superficial portion of the thigh are plainly seen.

The chart clearly illustrates Scarpa's triangle which corresponds to the depression seen immediately below the fold of the groin. It is a triangular space, the apex of which is directed downward, and the sides formed by the sartorius, internally by the abductor longus, and above by Poupart's ligament, under which the vessels are seen to pass. The floor of the space is formed from without inward by the iliacus, psoas, pectineus, a small part of the adductor brevis and the adductor longus muscles, and it is divided into two nearly equal parts by the femoral vessels which extend from the middle of its base to its apex, the artery giving off its cutaneous and profunda branches, the vein receiving the deep femoral and internal saphenous. On the outer side of the femoral artery is the anterior crural nerve.

The femoral artery is the continuation of the external iliac. It commences immediately behind Poupart's ligament, midway between the anterior superior spine of the ilium and the symphysis pubis, and passing down the fore part and inner side of the thigh, terminates at the opening in the adductor magnus, at the junction of the middle with the lower third of the thigh, where it becomes the popliteal artery. In the upper third of the thigh the femoral is contained in a triangular space called Scarpa's triangle. In the middle third of the thigh it is contained in an aponeurotic canal called Hunter's canal. The femoral artery is divided into a short trunk about an inch and a half or two inches and a half long, which is known as the common femoral artery, and the remainder of the vessel, which is known as the superficial femoral, to distinguish it from the deep femoral (profunda femoris, marked N), which is a large branch given off from the common femoral at its termination and which, by its derivation from the parent trunk marks the commencement of the superficial femoral artery.

The common femoral artery is very superficial, being covered by the skin and superficial fascia, superficial inguinal lymphatic glands, the iliac portion of the fascia, and the prolongation of the transversalis fascia which forms the sheath of the vessels. To the inner side of the artery can be seen the femoral vein (marked O), between the mar-

gins of the pectineus and psoas muscles. The two vessels are contained in a strong sheath. The two vessels, artery and vein are separated, however, one from the other by a thin fibrous partition.

The superficial femoral artery is only superficial where it lies in Scarpa's triangle. Here it is covered by the skin, superficial and deep fascia, and crossed by the internal cutaneous branch of the anterior crural nerve. In Hunter's canal it is more deeply seated, being covered by the integument, the superficial and deep fascia, the sartorius and aponeurotic covering of Hunter's canal.

Several cases have occurred where the femoral artery divided into two trunks below the origin of the profunda, and became reunited again near the opening in the adductor magnus so as to form a single popliteal artery.

The superior epigastric artery arises from the femoral about half an inch below Poupart's ligament, and passing through the saphenous opening in the fascia lata, ascends on the abdomen, in the superficial fascia covering the external oblique muscle, nearly as high as the umbilicus.

The superior circumflex iliac, the smallest of the cutaneous branches, arises close to the superior epigastric and, piercing the fascia lata, runs outward, parallel with Poupart's ligament, as far as the crest of the ilium, dividing into branches which supply the integument of the groin, the superficial fascia, and the superficial inguinal glands, anastomosing with the circumflex and with the gluteal and external circumflex arteries.

The superficial external pudic arises from the inner side of the femoral artery, close to the preceding vessels, and, after passing through the saphenous opening, courses inward, to be distributed to the integument on the lower part of the abdomen.

The profunda femoris (deep femoral artery) clearly equals the size of the superficial femoral. It arises from the outer and back part of the femoral artery from one to two inches below Poupart's ligament. It at first lies on the outer side of the superficial femoral, and then passes behind it and the femoral vein to the inner side of the femur, and, passing downward beneath the adductor longus, terminates at the lower third of the thigh in a small branch which pierces the adductor magnus, and is distributed to the flexor muscles back of the thigh, anastomosing with branches of the popliteal and inferior perforating arteries. Some of these branches may be seen in the colored illustrations.

Other branches that are not illustrated on the plates are the following: External circumflex artery, the transverse branches, the internal circumflex artery, perforating arteries, muscular branches, and the anastomotica branch. In the illustrations are seen the internal or long saphenous vein and the large femoral vein (marked P and O).

The femoral vein accompanies the artery of the same name through the upper two-thirds of the thigh. In the lower part of its course it lies external to the artery; higher up it is behind it; and at Poupart's ligament it lies to its inner side and on the same plane. It receives numerous muscular tributaries; the profunda femoris and deep external pudic veins join it near Poupart's ligament and about an inch and a half below the internal saphenous vein.

The internal or long saphenous vein, commences at the inner side of the arch on the

dorsum of the foot; it ascends in front and along the inner side of the leg, behind the inner margin of the tibia, accompanied by the internal saphenous nerve. At the knee it passes backward behind the inner condyle of the femur, ascends along the inside of the thigh, and, passing through the saphenous opening in the fascia lata, terminates in the femoral vein about an inch and a half below Poupart's ligament. This vein receives in its course cutaneous branches from the leg and thigh, and at the saphenous opening the superficial epigastric superficial circumflex iliac, the external pudic veins. The veins from the inner and back part of the thigh frequently unite to form a large vessel, which enters the main trunk near the saphenous opening; and sometimes those on the outer side of the thigh join to form another large vessel; so that occasionally three large veins are seen converging from different parts of the thigh toward the saphenous opening.

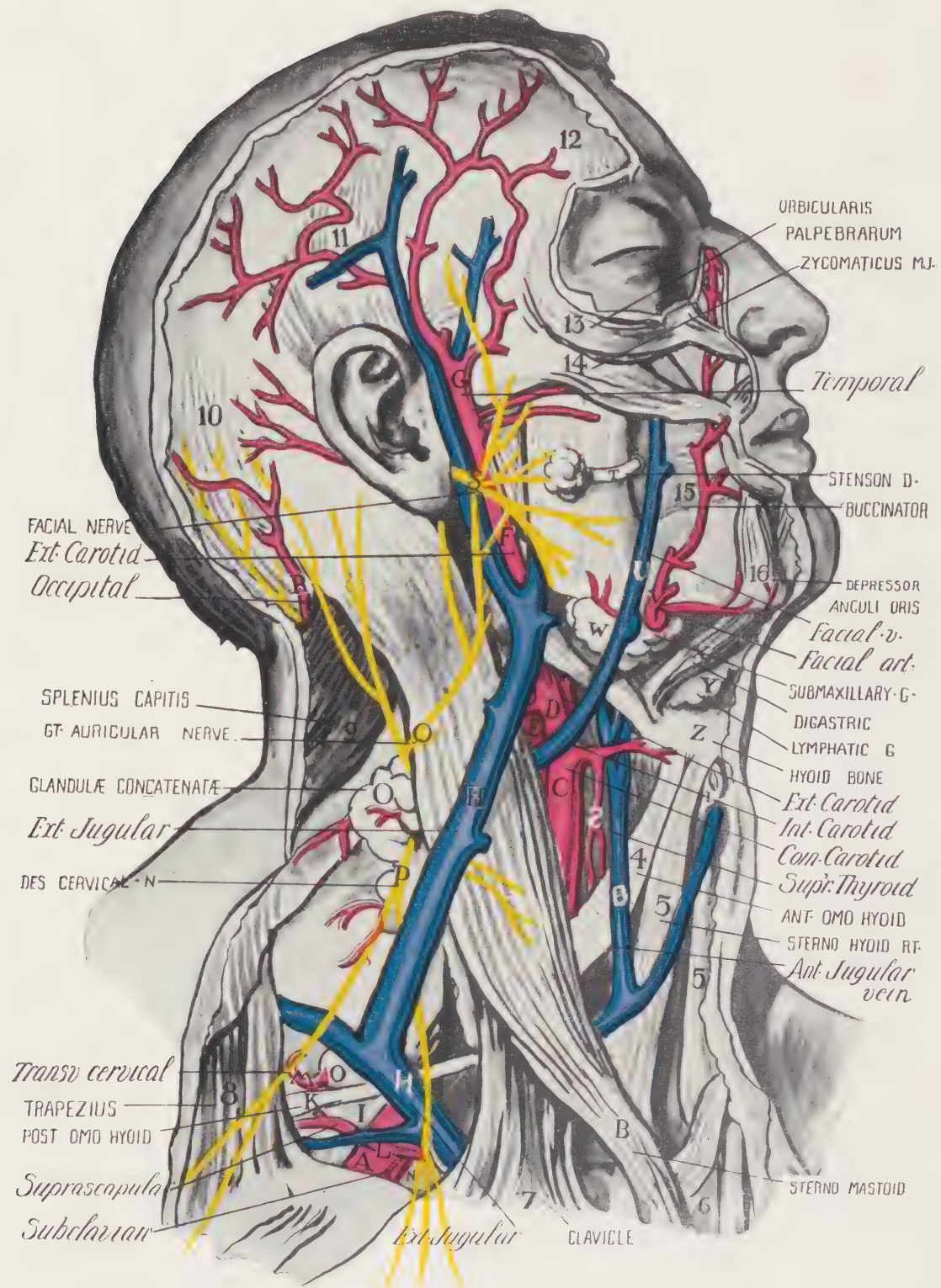
The internal saphenous vein communicates in the foot with the internal plantar vein; in the leg, with the posterior tibial veins by branches which perforate the tibial origin of the Soleus muscle, and also with the anterior tibial veins at the knee, with the articular veins; in the thigh, with femoral veins by one or more branches.

The external or short saphenous veins commence at the outer side of the arch on the dorsum of the foot, it ascends behind the outer malleolus, and along the outer border of the tendo Achilles, across which it passes at an acute angle to reach the middle line of the posterior portion of the leg. Passing directly upward it perforates the deep fascia in the lower part of the popliteal space, and terminates in the popliteal vein, and receives numerous large tributaries from the back part of the leg, and communicates with the deep veins on the dorsum of the foot and behind the other malleolus. Before it perforates the deep fascia it gives off a communicating branch, which passes upward and inward to join the internal saphenous vein.

The femoral artery and vein are excellent points from which the process of embalming may be performed. These vessels are large and their situation is such that they afford an excellent point for the distribution of the preserving solution. The femoral vein serves as an excellent point to pass the improved femoral vein tube. The right side is always to be selected for this purpose as the tube can be introduced into the external and common iliac as well as the ascending vena cava into the lower portion of the right side of the heart from which blood can be aspirated from all the veins of the body. The elevated position in which the body should always be placed, facilitates the removal of blood from the upper extremities first, thereby removing discoloration from those parts that are exposed to the view of friends and relatives. By the elevation of the hands above the head, and the aspiration of blood from the femoral vein through the vena cava, discoloration of the hands and ends of the fingers can easily be overcome.

The passage of the improved femoral vein tube is so simple that it insures constant use after being once tried. Its passage into the right auricle of the heart, which is the termination of the venous system, permits of the removal of blood from deep seated and superficial veins in all portions of the body.

Plate No. 23. RIGHT SIDE OF HEAD—ARTERIES, VEINS,
NERVES AND MUSCLES



The above illustration shows the right side of the head, with arteries, veins, nerves, and muscles. Sub-clavian artery marked (A), sterno mastoid muscle marked (B), common carotid artery marked (C), external carotid marked (D), internal carotid marked (E), continuation of external carotid marked (F), temporal artery marked (G), external jugular vein marked (H), suprascapular marked (L), occipital artery marked (R), facial vein marked (U), superior thyroid marked (S), facial artery marked (V).

Plate No. 23. RIGHT SIDE OF HEAD—ARTERIES, VEINS, NERVES AND MUSCLES

This colored plate clearly shows the arterial branches that supply preserving solution to the neck, face and cranium. The large veins that permit of drainage of blood from the head and neck can be easily traced on the colored anatomical chart.

The sub-clavian artery (marked A), sterno-mastoid muscle (marked B), common carotid artery (marked C), external carotid artery (marked D), internal carotid artery (marked E), continuation of external carotid artery (marked F), temporal artery (marked G), external jugular vein (marked H), supra-scapular (marked L), occipital artery (marked R), facial vein (marked U), superior thyroid (marked S), anterior jugular vein (marked 8).

It will be observed that the cranium, face and neck are dissected so as to expose the above marked branches of the veins and arteries, and give the reader a more intelligent idea of their course. The common carotid artery (marked C) passes upward from behind the sterno-clavicular articulation to a level with the upper border of the thyroid cartilage, opposite the third cervical vertebra, where it divides into the external and internal carotid; these names being derived from the distribution of the arteries to the external parts of the head and face and to the internal parts of the cranium.

The common carotid artery is contained in a sheath derived from the deep cervical fascia, which also encloses the internal jugular vein and pneumogastric nerve, the vein lying on the outer side of the artery, and the nerve between the artery and vein. At the lower part of the neck the common carotid artery is very deeply seated, being covered by the integument, superficial fascia, and deep cervical fascia, the sterno-mastoid, sterno-hyoid and sterno-thyroid muscles, but in the upper part of its course, near its termination, it is more superficial, being covered merely by the integument and inner margin of the sterno-mastoid, and is contained in a triangular space. This part of the artery is crossed obliquely, from within outward, by the sterno-mastoid artery; it is crossed also by one, or sometimes two superior thyroid veins, which terminate in the internal jugular. The middle thyroid vein crosses the artery about its middle, and the anterior jugular vein (marked 8), below.

External Carotid Artery

The external carotid artery commences opposite the upper border of the thyroid cartilage, and making a slightly curved course, passes upward and forward, and then inclines backward to the space between the neck of the condyle of the lower jaw, and the external meatus, where it divides into the superficial temporal and internal maxillary arteries. It rapidly diminishes in size in its course up the neck, owing to the number and large size of the branches given off from it. In the child it is somewhat smaller than the external carotid, but in the adult the two vessels are about equal in size.

Temporal Artery

The superficial temporal artery, the smaller of the two terminal branches of the external carotid, appears from its direction,

to be the continuation of that vessel. It commences in the substance of the carotid gland, in the interspace between the neck of the condyle of the lower jaw and the external meatus, and divides into two branches, an anterior and posterior. The anterior temporal inclines forward over the forehead, supplying the muscles, integument, and peri-cranium in this region, and anastomoses with the supra-orbital and frontal arteries.

The posterior temporal artery, larger than the anterior, curves upward and backward along the side of the head, lying superficial to the temporal fascia, and inosculates with the other posterior temporal of the opposite side, and with the posterior auricular and occipital arteries. The middle temporal artery arises immediately above the zygomatic arch, and perforating the temporal fascia, supplies the temporal muscle, anastomosing with the deep temporal branches of the internal maxillary. It occasionally gives off an orbital branch, which runs along the upper border of the zygoma, between the two layers of the temporal fascia, to the outer angle of the orbit.

External Jugular Vein

The external jugular vein receives the greater part of the blood from the exterior of the cranium and deep parts of the face, being formed by the junction of the posterior division of the temporo-maxillary and posterior auricular veins. It commences in the substance of the parotid gland, on a level with the angle of the lower jaw, and runs perpendicularly down the neck in the direction of a line drawn from the angle of the jaw to the middle of the clavicle. In its course it crosses the sterno-mastoid muscle, and runs parallel with its posterior border as far as its attachment with the clavicle, where it perforates the deep fascia, and terminates in the subclavian vein. In the neck it is separated from the sterno-mastoid by the anterior layer of the deep cervical fascia, and is covered by the platysma, the superficial fascia, and the integument. The external jugular varies in size, bearing an inverse proportion to that of the other veins of the neck, it is occasionally double. It is provided with two pairs of valves, the lower pair being placed at its entrance into the subclavian vein, the upper part in most cases about an inch and a half above the clavicle. The portion of vein between the two sets of valves is often dilated, and is termed the sinus. These valves do not prevent the regurgitation of the blood or the passage of fluid injected from below upward.

The Facial Vein

The facial vein commences as the root of the nose, being a direct continuation of the angular vein. It passes obliquely downward and outward, descends along the anterior border of the masseter, crosses over the body of the lower jaw with the facial artery, and passing obliquely outward and backward beneath the platysma and cervical fascia, unites with a branch of communication from the temporo-maxillary vein to form a trunk of large size which enters the internal jugular vein. From near its termination a communicating branch often runs down the anterior border of the sterno-

mastoid to join the lower part of the anterior jugular. The facial vein receives near the angle of the mouth, communicating tributaries of considerable size, namely the deep facial or anterior internal maxillary vein, from the pterygoid plexus. It is also joined by the inferior palpebral, the superior and inferior labial veins, the buccal veins from the cheek, and the masseteric veins. Below the jaw it receives the submental; the inferior palatine, which returns the blood from the plexus around the tonsil and soft palatine, which returns the blood from the plexus around the tonsil and soft palate; the sub-maxillary vein, which commences in the sub-maxillary gland; and, generally the ranine vein.

The anterior jugular vein commences near the hyoid bone from the convergence of several superficial veins from the sub-maxillary region. It passes down between the median line and the anterior border of the sterno-mastoid, and at the lower part of the neck passes beneath that muscle to open into the termination of the external jugular or into the subclavian vein. This vein varies considerably in size, bearing almost always an inverse proportion to the external jugular. Most frequently there are two anterior jugulars, right and left, but occasionally only one. This vein receives some laryngeal veins, and occasionally a small thyroid vein. Just above the sternum the two anterior jugular veins communicate by a transverse trunk, which receives tributaries from the inferior thyroid veins. It also communicates with the internal jugular. There are no valves in this vein.

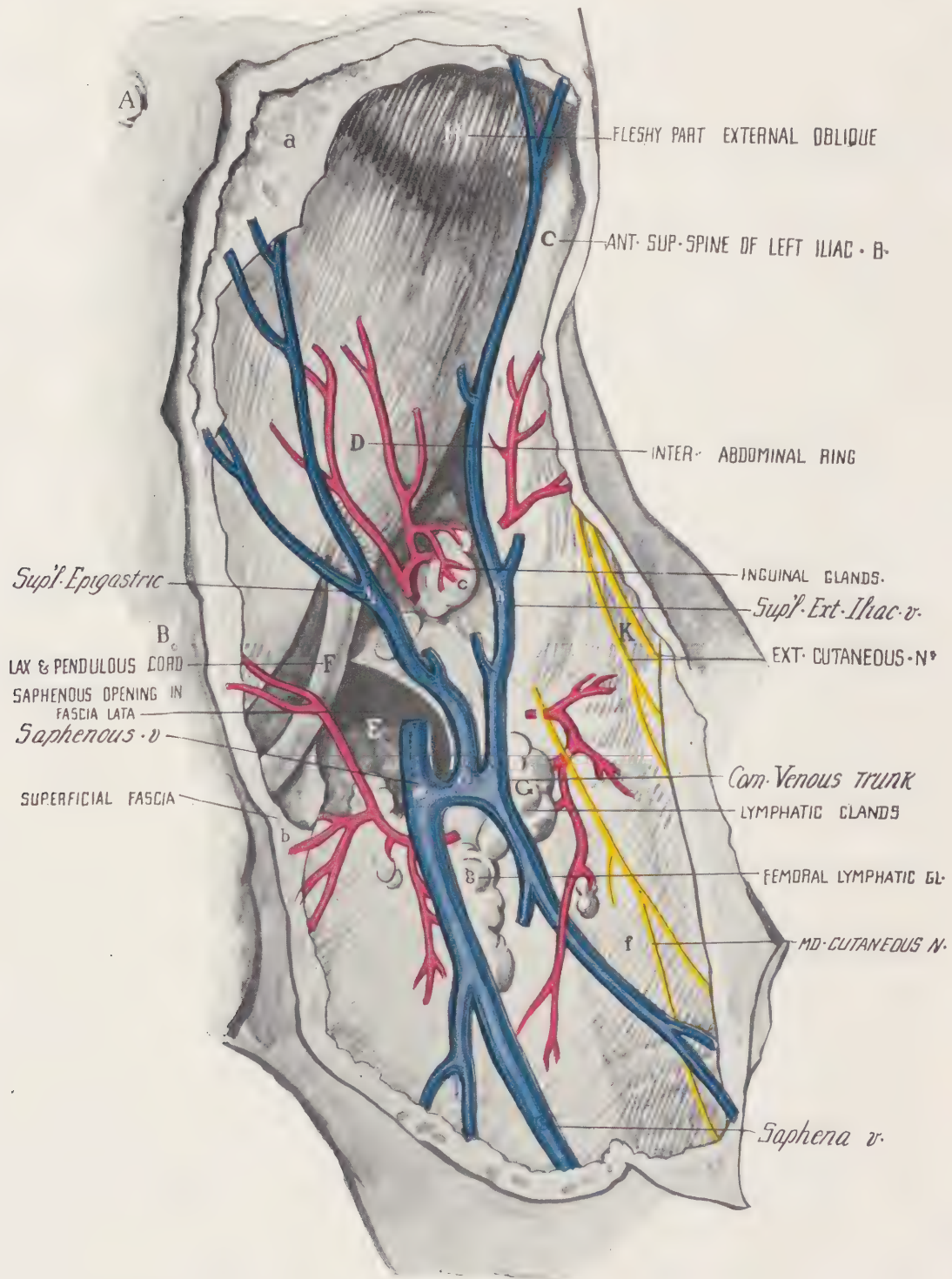
The Temporal Vein

The temporal vein commences by a minute plexus on the side and vortex of the skull, which communicates with frontal and supra-orbital veins in front, the corresponding vein of the opposite side, and the posterior auricular and occipital veins behind. From this network, anterior and posterior branches are formed which unite above the zygoma, forming the trunk of the vein. This trunk is joined by a large vein, the middle temporal, which receives the blood from the substance of the temporal muscle and pierces the fascia at the upper border of the zygoma. The temporal vein then descends between the external auditory meatus and the condyle of the jaw, enters the substance of the parotid gland, and unites with the internal maxillary vein to form the temporo-maxillary vein.

The temporal vein receives in its course some parotid veins, an articular branch from the articulation of the jaw, anterior auricular veins from the external ear, and a vein of large size, the transverse facial, from the side of the face. The middle temporal vein, previous to its junction with the temporal vein, receives a branch, the orbital vein, which is formed by some external palpebral branches, and passes backward between the layers of the temporal fascia. The temporal vein is plainly seen following the temporal artery which is marked (G).

The internal vein is not described on this colored plate, but the course of the sterno-mastoid muscle is describe instead and is marked (B).

Plate No. 24. VEINS OF LOWER EXTREMITY AND ABDOMEN



The above illustration shows veins of lower extremity and abdomen. Umbilicus marked (A), anterior superior spine of left ilium marked (C), interabdominal ring marked (D), superior external iliac vein marked (h), superior epigastric vein marked (i), saphena vein marked (e), superficial fascia marked (b), lymphatic glands marked (G), femoral lymphatic glands marked (g).

Plate No. 24. VEINS OF LOWER EXTREMITY AND ABDOMEN

This colored plate shows the arterial and venous branches of the upper part of the thigh and lower section of the abdomen. The arterial branches showing how the preserving solution is conveyed to these parts, and the veins how the blood is drained from them.

The umbilicus is marked (A), Anterior superior spine of left ilium marked (C), Inter abdomina ring marked (D), Superior external iliac vein marked (h), Superior epigastric vein marked (i), Saphena vein marked (e), Superficial fascia marked (b), Lymphatic glands marked (G), Femoral lymphatic glands marked (g).

The veins of the lower extremity are subdivided like those of the upper extremity into two sets, superficial and deep, the superficial veins being placed beneath the integument, between the two layers of superficial fascia, the deep veins accompanying the arteries and forming the venae comites of those vessels. Both sets of veins are provided with valves, which are more numerous in the deep than in the superficial set. These valves are more numerous in the lower than in the upper limb. The superficial veins of the lower extremity are the internal, or long, saphenous and the external, or short, saphenous.

Long Saphenous Vein

The internal, or long, saphenous vein commences at the inner side of the arch of the dorsum of the foot; it ascends in front of the inner malleolus and along the inner side of the leg, behind the inner margin of the tibia, accompanied to the internal saphenous nerve. At the knee it passes backward behind the inner condyle of the femur, ascends along the inner side of the thigh, and passing through the saphenous opening in the fascia lata, terminates in the femoral vein about an inch and a half Poupart's ligament. This vein receives in its course cutaneous tributaries from the leg and thigh, and at the saphenous opening the superficial epigastric, superficial circumflex iliac, and external pudic veins; all of which are shown on the colored supplement. The veins from the inner and back part of the thigh frequently unite to form a large vessel, which enters the main trunk near the saphenous opening; and sometimes those on the outer side of the thigh join to form another large vessel; so that occasionally three large veins are seen converging from different parts of the thigh toward the saphenous opening. The internal saphenous vein communicates in the foot with the internal plantar vein; in the leg, with the posterior tibial veins by branches which perforate the tibial origin of the Soleus muscle, and also with the anterior tibial veins; at the knee, with the articular veins; in the thigh, with the femoral vein by one or more branches. The valves in this vein vary in number from two to six and are more numerous in the thigh than in the leg.

Short Saphenous Vein

The external or short saphenous vein commences at the outer side of the arch on the dorsum of the foot; it ascends behind the outer malleolus, and along the outer border of the tendo Achilles, across which it passes at an acute angle to reach the middle line of the posterior aspect of the leg. Passing directly upward, it perforates the deep fascia in the lower part of the popliteal space, and

terminates in the popliteal vein. It receives numerous large tributaries from the back part of the leg, and communicates with the deep veins on the dorsum of the foot, and behind the outer malleolus. Before it perforates the deep fascia it gives off a communicating branch, which passes upward and inward to join the internal saphenous vein. This vein has a variable number of valves, from three to nine, one of which is always found near its termination in the popliteal vein.

The arterial branches illustrated on the colored supplement are the superficial epigastric, superficial circumflex iliac, superficial external pudic and deep external pudic.

The Superficial Epigastric Artery

The superficial epigastric artery arises from the femoral about half an inch below the Poupart's ligament, and, passing through the saphenous opening in the fascia lata, ascends on the abdomen, in the superficial fascia covering the external oblique muscle, nearly as high as the umbilicus. It describes branches to the superficial inguinal glands, the superficial fascia, and the integument, anastomosing with branches of the deep epigastric.

The Superficial Circumflex Iliac Artery

The superficial circumflex iliac artery, the smallest of the cutaneous branches, arises close to the preceding, and, piercing the fascia lata, runs outward, parallel with Poupart's ligament, as far as the crest of the ilium, dividing into branches which supply the integument of the groin, the superficial fascia, and the superficial inguinal lymphatic glands, anastomosing with the circumflex iliac and with the gluteal and external circumflex arteries.

The Superficial External Pudic Artery

The superficial external pudic artery arises from the inner side of the femoral artery, close to the preceding vessels, and, after passing through the saphenous opening, courses inward across the spermatic cord or round ligament, to be distributed to the integument on the lower part of the abdomen, the penis and scrotum in the male, and the labium in the female, anastomosing with branches of the internal pudic.

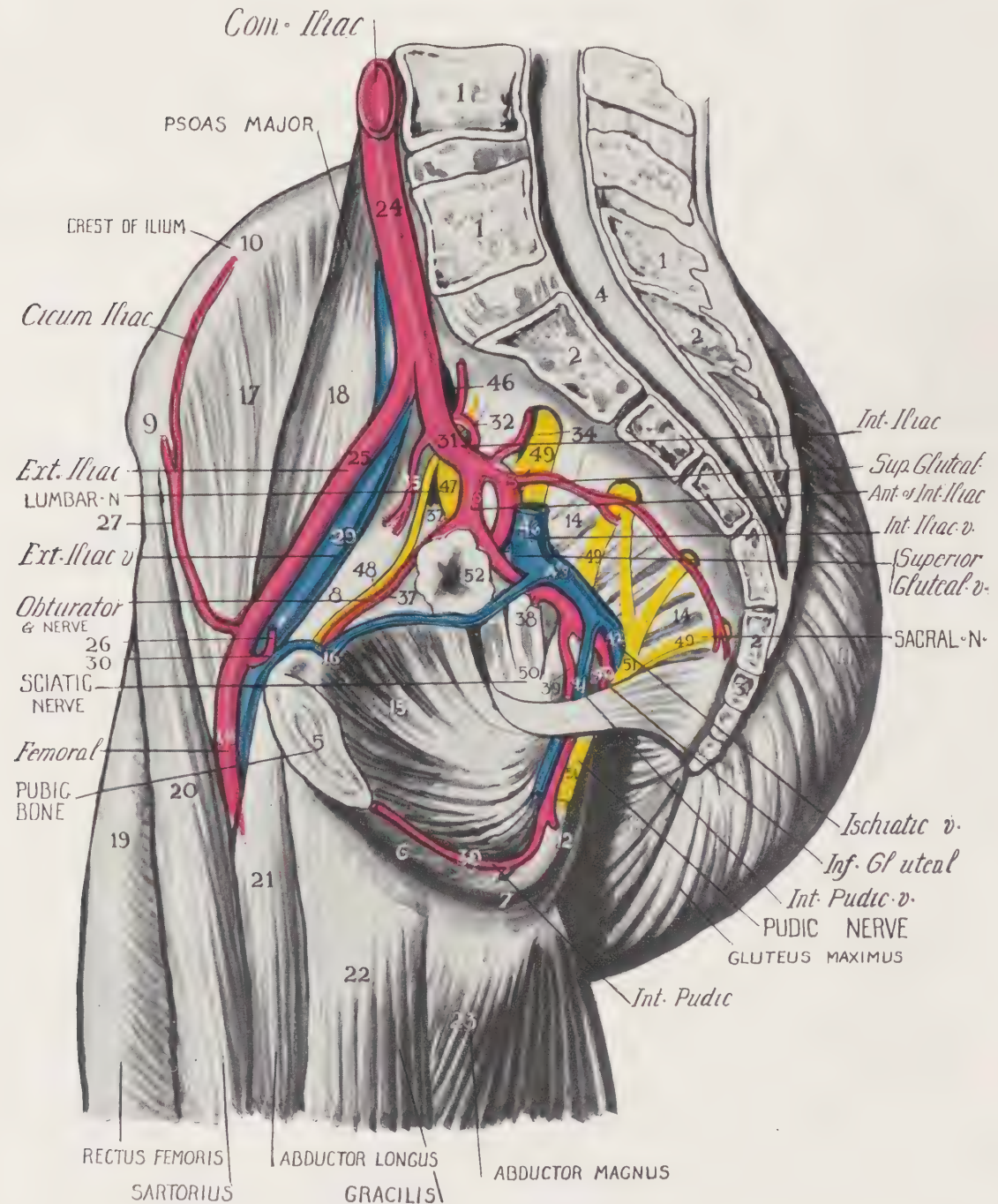
Deep External Pudic Artery

The deep external pudic artery, more deeply seated than the preceding, passes inward on the pectineus muscle, covered by the fascia lata, which it pierces at the inner border of the thigh, its branches being distributed, in the male, to the integument of the scrotum and perinaeum; and in the female, to the labium, anastomosing with branches of the superficial perineal artery.

A part of the external circumflex artery is seen which supplies the muscles on the front of the thigh. It arises from the outer side of the profunda, passes horizontally outward, between the divisions of the anterior crural nerve and behind the sartorius and rectus muscles, and divides into three sets of branches, ascending, transverse, and descending.

The arterial branches printed in red are not lettered so each branch can be followed, but an observation of the colored supplement will give the reader a good idea of the course pursued by each, and the above description of their course will enable the reader to form a good idea of the parts they supply.

Plate No. 25. ARTERIES, VEINS AND NERVES OF THE PELVIS



This illustration shows the pelvic cavity, termination of the vertebral column, and the arteries, veins, nerves and muscles. The right common iliac artery is numbered (24), external iliac artery number (25), internal iliac artery number (31), femoral artery number (28), anterior branch of internal iliac number (26), internal circumflex iliac number (27), external iliac vein number (29), superior vesical number (33), internal pudic artery number (39), inferior gluteal artery number (40), internal pudic vein number (41), ischiatic vein number (42), superior gluteal artery number (43), rectus femoris muscle number (19), sartorius muscle number (20), adductor longus muscle number (22), gluteus maximus muscle number (11).

Plate No. 25. ARTERIES, VEINS AND NERVES OF THE PELVIS

This colored plate is of much importance to the embalmer as it displays the various arterial branches that distribute preserving solutions to the region of the pelvis. The various arteries, veins and nerves are lettered so as to permit the reader more easily to follow their course. The illustration shows the pelvic cavity, termination of the vertebral column, and the arteries, veins, nerves and muscles. The right common iliac artery (24), external iliac artery (25), internal iliac artery (31), femoral artery (28), anterior branch of internal iliac (26), internal circumflex iliac (27), external iliac vein (29), superior vesical (33), internal pudic artery (39), inferior gluteal artery (40), internal pudic vein (41), ischiatic vein (42), superior gluteal artery (43), rectus femoris muscle (19), sartorius muscle (20), adductor longus muscle (22), gluteus maximus muscle (11).

The Right Common Iliac Artery

The right common iliac artery (24) is somewhat larger than the left, and passes more obliquely across the body of the last lumbar vertebra. In front of it are the peritoneum, the small intestine, branches of the sympathetic nerve, and, at its point of division, the ureter. Behind, it is separated from the last two lumbar vertebrae by the two common iliac veins. On its outer side, it is in relation with the inferior vena cava and the right common iliac vein above, and the Psoas magnus muscle below.

External Iliac Artery

The external iliac artery (25) is larger in the adult than the internal iliac, and passes obliquely downward and outward along the inner border of the Psoas muscle (18), from the bifurcation of the common iliac to Poupart's ligament, where it enters the thigh and becomes the femoral artery.

Internal Iliac Artery

The internal iliac artery (31) supplies the walls and viscera of the pelvis, the generative organs, and inner side of the thigh. It is a short, thick vessel, smaller in the adult than the external iliac, and about an inch and a half in length. It arises at the point of bifurcation of the common iliac, and, passing downward to the upper margin of the great sacrosciatic foramen, divides into two large trunks, the anterior and posterior; from its point of bifurcation a partially ob-

literated cord, the hypogastric artery, extends forward to the bladder.

Femoral Artery

The femoral artery (28) is the continuation of the external iliac. It commences immediately behind Poupart's ligament, midway between the anterior superior spine of the ilium (9) and the symphysis pubis (5), and, passing down the fore part and inner side of the thigh, terminates at the opening in the adductor magnus, at the junction of the middle with the lower third of the thigh, where it becomes the popliteal artery. The vessel, at the upper part of the thigh, lies a little internal to the head of the femur; in the lower part of its course, on the inner side of the shaft of the bone, and between these two parts the vessel is far away from the bone. In the upper third of the thigh it is contained in a triangular space called Scarpa's triangle. In the middle third of the thigh it is contained in an aponeuretic canal called Hunter's canal.

Scarpa's Triangle

Scarpa's triangle corresponds to the depression seen immediately below the fold of the groin. It is a triangular space, the apex of which is directed downward, and the sides formed externally by the sartorius, internally by the adductor longus, and above Poupart's ligament. The floor of the space is formed from without inward by the iliacus, psoas, pectineus, a small part of the adductor brevis and the adductor longus muscles; and it is divided into two nearly equal parts by the femoral vessels, which extend from the middle of its base to its apex, the artery giving off in this situation its cutaneous and profunda branches, the vein receiving the deep femoral and internal saphenous.

Deep Circumflex Iliac Artery

The deep circumflex iliac artery (27) arises from the outer side of the external iliac artery nearly opposite the epigastric artery. It ascends obliquely outward behind Poupart's ligament, contained in a fibrous sheath formed by the junction of the transversalis and iliac fasciae, to the anterior superior spinous process of the ilium. It then runs along the inner surface of the crest of the ilium to about its middle, where it pierces the transversalis, and runs backward between that muscle and the internal oblique, to an-

astomose with the ilio-lumbar and gluteal arteries. Opposite the anterior spine of the ilium it gives off a large branch, which ascends between the internal oblique and transversalis muscles, supplying them, and anastomosing with the lumbar and epigastric arteries.

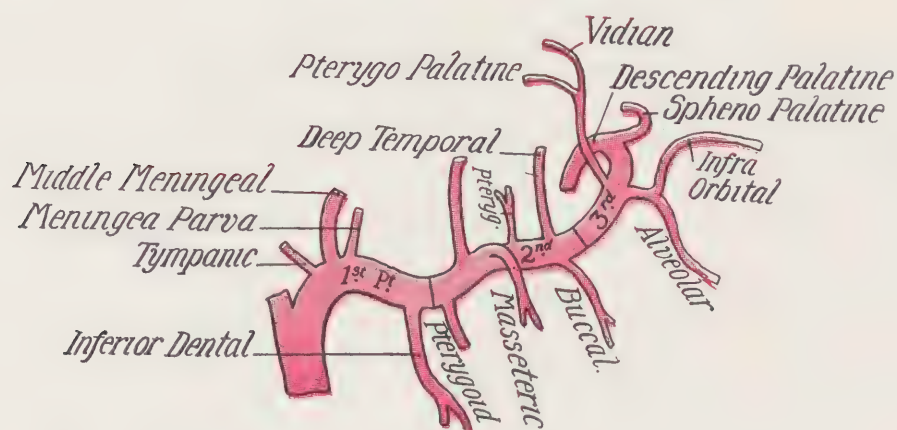
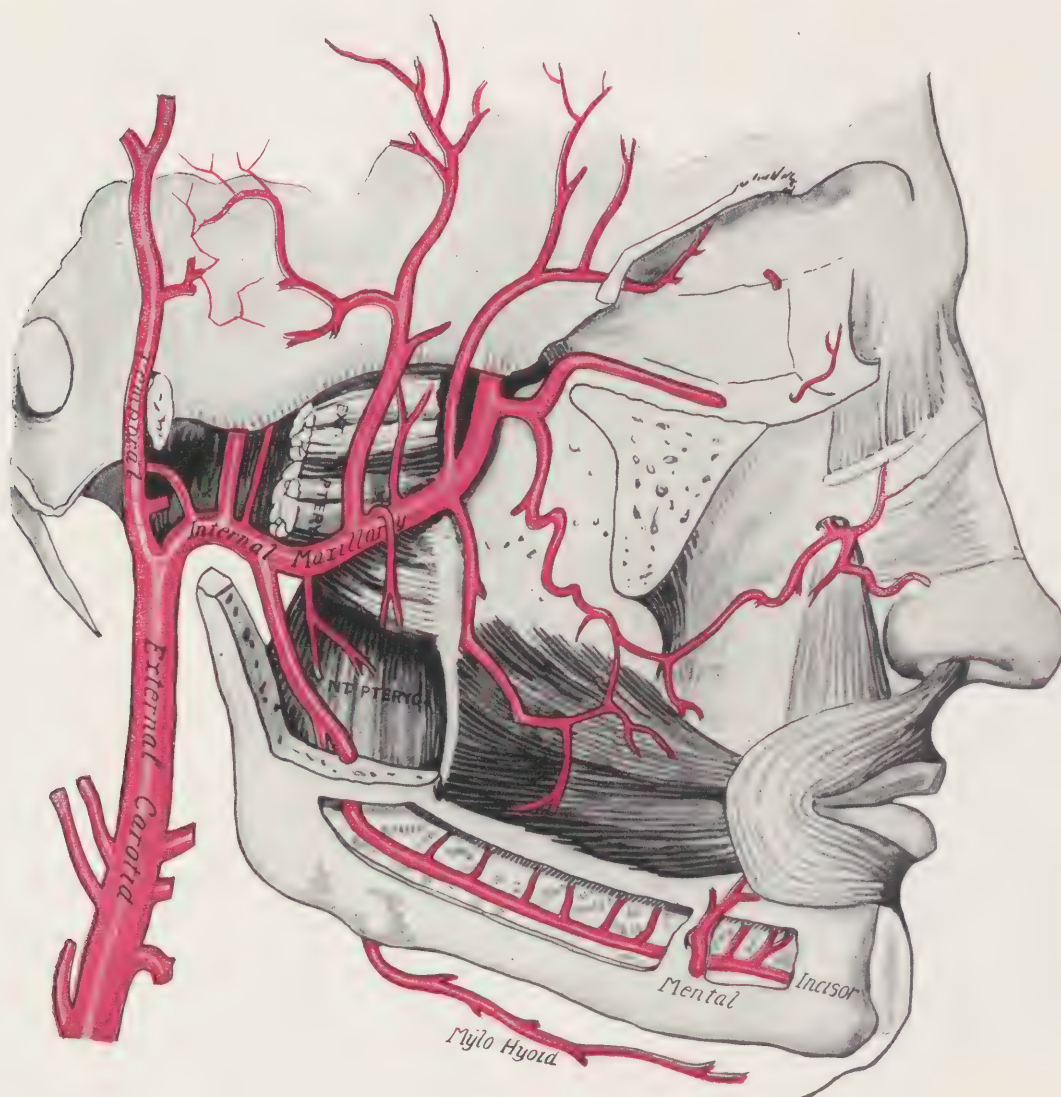
Internal Pudic Artery

The internal pudic artery (39) is the smaller of the two terminal branches of the anterior trunk of the internal iliac, and supplies the external organs of generation. Though the course of the artery is the same in both sexes, the vessel is much smaller in the female than in the male, and the distribution of its branches somewhat different.

Gluteal Artery

The gluteal artery (40) is the largest branch of the internal iliac, and appears to be the continuation of the posterior division of that vessel. It is a short, thick trunk, which passes out of the pelvis above the upper border of the pyriformis muscle, and immediately divides into a superficial and deep branch. Within the pelvis it gives off a few muscular branches to the iliacus pyriformis, and obturator internus, and, just previous to leaving that cavity, a nutrient artery, which enters the ilium. The superficial branch passes beneath the gluteus maximum and divides into numerous branches, some of which supply the muscle, whilst others perforate its tendinous origin, and supply the integument covering the posterior surface of the sacrum, anastomosing with the posterior branches of the sacral arteries. The deep branch runs between the gluteus medius and minimus, and sub-divides into two. Of these, the superior division, containing the original course of the vessel, passes along the upper border of the gluteus minimus to the anterior superior spine of the ilium, anastomosing with the circumflex iliac and ascending branches of the external circumflex artery. The inferior division crosses the gluteus minimus obliquely to the trechanter major, distributing branches to the glutei muscles, and inosculates with the external circumflex artery. Some branches pierce the Gluteus minimus to supply the hip joint. It must be plain to the reader, after consulting the colored plate, how the fluid is conveyed to the large muscles back of the thigh and pelvis.

Plate No. 26.
BRANCHES OF THE INTERNAL MAXILLARY ARTERY



The above illustration shows the internal maxillary artery and its branches. The external carotid artery is seen ascending upwards giving off the temporal and internal maxillary artery. This colored plate is intended to illustrate the various branches that this internal branch gives off to supply the various parts of the face and lower jaw. The smaller branches in the colored plate have not been marked with their respective names to identify them, but from the description of these branches, which appears in this issue of The Casket, they may be easily traced to the various parts of the face and jaw.

Plate No. 26.

BRANCHES OF THE INTERNAL MAXILLARY ARTERY

The internal maxillary artery, the larger of the two terminal branches of the external carotid artery, passes upward, at right angles from the vessel, to the inner side of the neck of the condyle of the lower jaw, to supply the deep structures of the face. At its origin, it is embedded in the substance of the parotid gland, being on a level with the lower extremity of the lobule of the ear. In the first part of its course (maxillary portion) the artery passes horizontally forward and inward, between the ramus of the jaw and the internal lateral ligament. The artery here lies parallel with the auriculo-temporal nerve; it crosses the inferior muscle. In the second part of its course (pterygoid portion) it runs obliquely forward and upward upon the outer surface of the external pterygoid muscle, being covered by the ramus of the lower jaw and lower part of the temporal muscle. In the third part of its course (spheno-maxillary portion) it approaches the superior maxillary bone, and enters the spheno-maxillary fossa in the interval between the two heads of the external pterygoid, where it lies in relation with Meckel's ganglion, and gives off its terminal branches. The branches of this vessel may be divided into three groups, corresponding with its three divisions:

Tympanic Artery

The tympanic branch passes upward behind the articulation of the lower jaw, enters the tympanum through the Glaserian fissure, which can be distinctly seen on the colored illustration, and ramifies upon the membrana tympani, forming a vascular circle around the membrane with the stylo-mastoid artery, and anastomosing with the Vidian and the tympanic branch from the internal carotid. It gives off a branch (deep auricular) to the external meatus, supplying its lining and the outer surface of the membrana tympani.

Middle Meningeal Artery

The middle meningeal is the largest of the branches which supply the dura mater. It arises from the internal maxillary, between the internal lateral ligament and the neck of the jaw, and passes vertically upward between the two roots of the auriculo-temporal nerve to the foramen spinosum of the sphenoid bone. On entering the cranium it divides into two branches, anterior and posterior. The anterior branch, the larger, crosses the great ala of the sphenoid, and reaches the groove, or canal, in the anterior inferior angle of the parietal bone it then divides into branches which spread out between the dura mater and internal surface of the cranium, some passing upward over the parietal bone as far as the vertex, the others backward to the occipital bone. The posterior branch crosses the squamous portion of the temporal, and on the inner surface of the parietal bone divides into branches which supply the posterior part of the dura mater and cranium. The branches of this vessel are distributed partly to the dura mater, but chiefly to the bones; the anastomose with the arteries of the opposite side, and with the anterior and posterior meningeal. The middle meningeal on entering the cranium gives off the following collateral branches:

First: Numerous small branches to the ganglion of the fifth nerve and to the dura mater in this situation. Second: A branch (petrosal branch), which enters the hiatus fallopii, supplies the facial nerve, and anastomoses with the stylomastoid branch of the posterior auricular artery. Third: Orbital branches, which pass through the sphenoidal

fissure or through separate canals in the great wing of the sphenoid to anastomose with the lachrymal or other branches of the ophthalmic artery. Fourth: Temporal branches, which pass through foramina in the great wing of the sphenoid, and anastomose in the temporal fossa with the deep temporal arteries. The small meningeal is sometimes derived from the preceding. It enters the skull through the foramen ovale, and supplies the Gasserian ganglion and dura mater. Before entering the cranium it gives off a branch to the nasal fossa, soft palate, and tonsil.

The Inferior Dental

The inferior dental descends with the dental nerve to the foramen on the inner side of the ramus of the jaw. It runs along the dental canal in the substance of the bone, accompanied by the nerve, none of which are shown on the illustration, and opposite the first bicuspid tooth divides into two branches, incisor and mental which are plainly lettered on the colored illustration; the former is continued forward beneath the incisor teeth as far as the symphysis, where it anastomoses with the artery of the opposite side; the mental branch escapes with the nerve at the mental foramen, supplies the structures composing the chin, and anastomoses with the submental, inferior labial, and inferior coronary arteries. As the dental artery enters the foramen it gives off a mylohyoid branch, which runs in the mylohyoid groove, and ramifies on the under surface of the mylohyoid muscle. The dental and incisor arteries during their course through the substance of the bone give off a few twigs which are lost in the cancellous tissue, and a series of branches which correspond in number to the roots of the teeth, these enter the minute apertures at the extremities of the fangs and supply the pulp of the teeth.

Branches of the second or pterygoid portion of the internal maxillary artery are as follows: deep temporal, pterygoid, masseteric and buccal. These branches are distributed as their names imply, to the muscles in the maxillary region. The colored illustration at the bottom of the page shows the branches in the first, second and third portions.

Deep Temporal Arteries

The deep temporal arteries, two in number, anterior and posterior, each occupy that part of the temporal fossa indicated by its name. Ascending between the temporal muscle and pericranium, they supply that muscle and anastomose with the other temporal arteries; the anterior branch communicating with the lachrymal through small branches which perforate the malar bone and great wing of the sphenoid. The pterygoid branches, irregular in their number and origin, supply the pterygoid muscles.

The masseteric is a small branch which passes outward, above the sigmoid notch of the lower jaw, to the deep surface of the masseter. It supplies that muscle and anastomoses with the masseteric branches of the facial and with the transverse facial artery.

The buccal is a small branch which runs obliquely forward between the internal pterygoid and the ramus of the jaw, to the outer surface of the Buccinator, to which it is distributed, anastomosing with branches of the facial artery.

Branches of the third or spheno-maxillary portion of the internal maxillary artery are as follows: alveolar, infra-orbital, posterior or descending palatine, vidian, pterygo-palatine and naso or spheno-palatine.

The Alveolar Artery

The alveolar or posterior dental branch is given off from the internal maxillary by a common branch with the infraorbital, and just as the trunk of the vessel is passing into the spheno-maxillary fossa. Descending on the tuberosity of the superior maxillary bone, it divides into numerous branches, some of which enter the posterior dental canals, to supply the molar and bicuspid teeth and the lining of the antrum, and others are continued forward on the alveolar process to supply the gums.

The Infra-Orbital Artery

The infra-orbital appears, from its direction, to be the continuation of the trunk of the internal maxillary. It arises from that vessel by a common trunk with the preceding branch, and runs along the infra-orbital canal with the superior maxillary nerve, emerging on the face at the infra-orbital foramen, beneath the levator labii superioris. Whilst contained in the canal, it gives off branches which ascend into the orbit, and supply the inferior rectus and inferior oblique muscles and the lachrymal gland. Other branches, anterior dental, descend through canals in the bone to supply the mucous membrane of the antrum and the front teeth of the upper jaw. On the face some branches pass inward toward the nose, anastomosing with the angular branch of the facial artery and nasal branch of the ophthalmic; and other branches descend beneath the levator labii superioris and anastomose with the transverse facial and buccal branches. The four remaining branches arise from that portion of the internal maxillary which is contained in the spheno-maxillary fossa.

Descending Palatine Artery

The descending palatine artery passes down the posterior palatine canal with the anterior palatine branch of Meckel's ganglion, and, emerging from the posterior palatine foramen, runs forward in a groove on the inner side of the alveolar border of the hard palate to the anterior palatine canal, where the terminal branch of the artery passes upward through the foramen of Stenson to anastomose with the naso-palatine artery. Its branches are distributed to the gums, the mucous membrane of the hard palate, and the palatine glands. While it is contained in the palatine canal it gives off branches which descend in the accessory palatine canals to supply the soft palate and tonsil, anastomosing with the ascending palatine artery.

The Vidian Artery

The vidian branch passes backward along the vidian canal with the vidian nerve. It is distributed to the upper part of the pharynx and eustachian tube, sending a small branch into the tympanum, which anastomoses with the anterior tympanic.

The Pterygo Palatine Artery

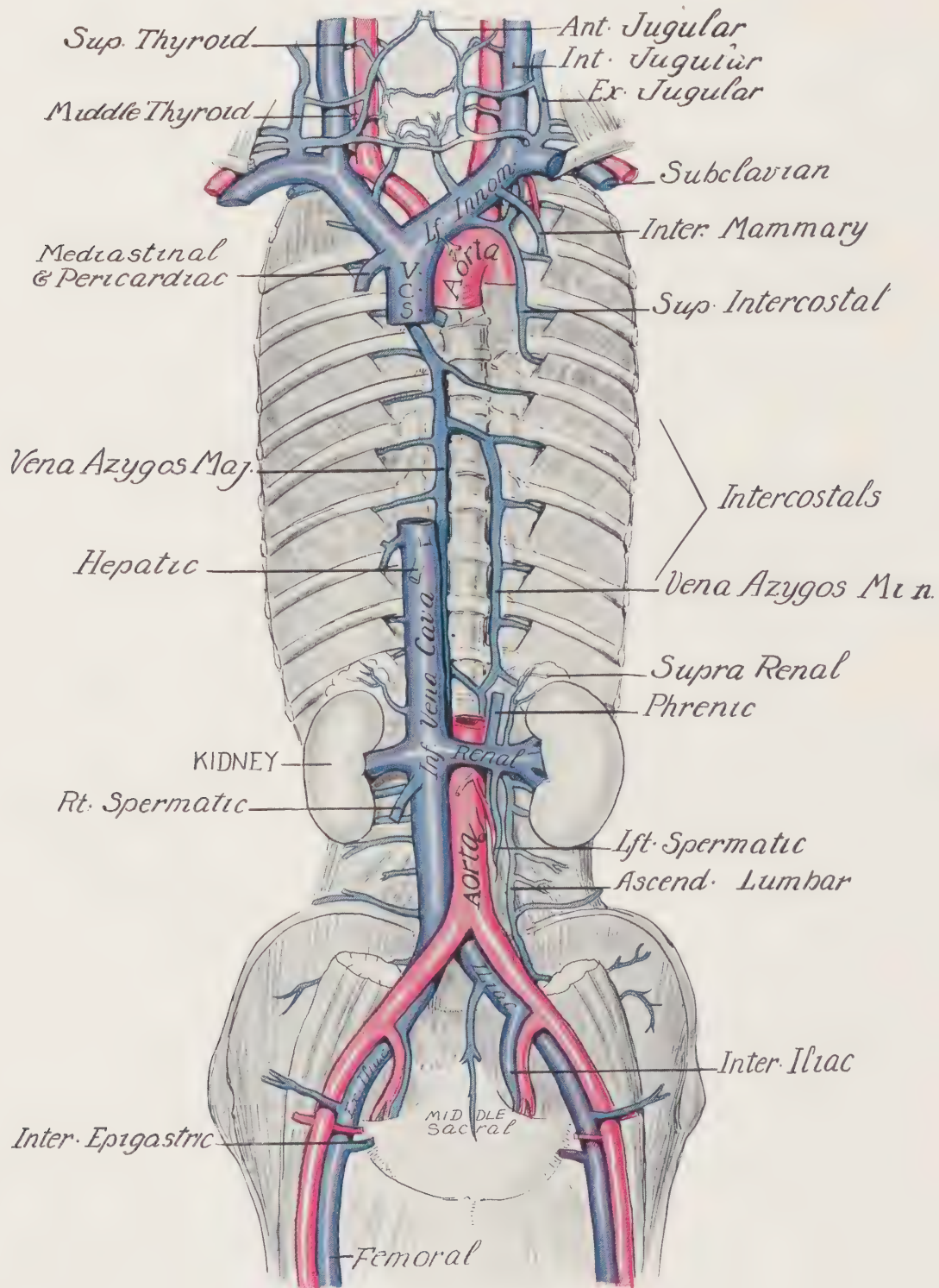
The pterygo-palatine is also a very small branch, which passes backward through the pterygo palatine canal with the pharyngeal nerve, and is distributed to the upper part of the pharynx and eustachian tube.

The Spheno Palatine Artery

The spheno palatine artery passes through the spheno palatine foramen into the cavity of the nose, at the back part of the superior meatus, and divides into two branches, one internal, the naso palatine or superior artery of the septum, passes obliquely downward and forward along the septum nasi, supplies the mucous membrane, and anastomoses in front with the terminal branch of the descending palatine. The external branches, two or three in number, supply the mucous membrane covering the lateral wall of the nose, the antrum, and the ethmoid and sphenoid cells.

By consulting the colored plate it will be clearly seen how thoroughly the preserving solutions penetrate to the innermost recesses of the head, liberally supplying every conceivable part with its pro-rata share of fluid. Of course, the thorough injection of the arteries is of the utmost importance, otherwise putrefactive changes will take place.

Plate No. 27. SUPERIOR AND INFERIOR VENA CAVA AND BRANCHES



This illustration shows the various branches given off by both the large arteries and veins in the trunk of the body. The formation of the venous branches with those of the vena cava superior and inferior are plainly seen, as well as the connection between these large trunks. The azygos veins, major and minor, are distinctly seen connecting the vena cavae. By studying the venous formation in the above colored plate, the facility with which blood may be removed with the improved blood tubes from the right auricle of the heart, must be evident to the reader.

Plate No. 27. SUPERIOR AND INFERIOR VENA CAVA AND BRANCHES

The importance of removing blood to as great an extent as possible in all cases cannot be over estimated. This colored plate illustrates the various branches given off by both the large venous trunks in the trunk of the body.

The tributary branches that empty their contents into the superior and inferior vena cava are clearly illustrated on the colored chart.

The azygos veins that form a connection between the superior and inferior vena cava pass behind the heart, but in the colored illustration the heart has been removed so as to clearly illustrate their exact position.

A study of the colored illustration will enable the reader to readily understand the facility with which the blood can be removed from the body by means of the improved blood tubes, from the right auricle of the heart, which is the terminus of the venous system.

A description of the various venous branches, the parts of the body they drain and the manner in which they communicate with each other will be of great value to the progressive embalmer.

Veins of the Neck

The veins of the neck, which return the blood from the head and face are the external jugular. Internal jugular, posterior external jugular, anterior jugular, vertebral, posterior auricular vein and occipital veins.

The External Jugular Vein

The external jugular vein receives the greater part of the blood from the outside of the cranium and deep parts of the face, being formed by the junction of the posterior division of the temporo maxillary and posterior auricular veins. It commences in the substance of the parotid gland on a level with the angle of the lower jaw, and runs perpendicularly down the neck in the direction of a line drawn from the angle of the jaw to the middle of the clavicle. In its course it crosses the sterno-mastoid muscle, and runs parallel with its posterior border, as far as its attachment to the clavicle, where it perforates the deep fascia, and terminates in the sub-clavian vein, on the outer side of or in front of the scalenus anticus muscle.

Pressure at this point will generally make this vein very pronounced by interrupting the returning blood current thereby dilating the vein. In the neck it is separated from the sterno mastoid by the anterior layer of the deep cervical fascia and is covered by the platysma, the superficial fascia and the integument. This vein is crossed about its middle by the superficial cervical nerve.

The external jugular vein varies in size, bearing an inverse proportion to that of the other veins of the neck, and is occasionally double. It is provided with two pairs of valves, the lower pair being placed at its entrance into the sub-clavian vein, the upper pair in most cases about one and a half inches above the clavicle. The portion of vein between the two sets of valves is often dilated, and is called the sinus.

The valves do not prevent the regurgitation of the blood or the passage of injections from below. It is therefore easy to understand how and why the face becomes flushed when fluid is injected into the arteries before blood is aspirated from the veins. It is also easy to account for the discolored features complained of generally by those who also inject fluid into the veins. Of course, the

injection of a small amount of fluid into the veins may not cause pronounced discoloration in every case, but the tendency to discolor the features is very likely when any amount of fluid is injected to cause regurgitation of blood in the jugular veins.

This vein receives the occipital occasionally, the posterior external jugular, and near its termination the suprascapular and transverse cervical veins. It communicates with the anterior jugular, and in the substance of the parotid receives a large branch of communication from the internal jugular.

The Posterior External Jugular

The posterior external jugular vein returns the blood from the integument and superficial muscles in the upper and back part of the neck lying between the splenius and trapezius muscles. It runs down the back part of the neck, and opens into the external jugular just below the middle of its course.

The Anterior Jugular Vein

The anterior jugular vein commences near the hyoid bone from the convergence of several superficial veins, from the sub-maxillary region. It passes down between the median line and the anterior border of the sterno-mastoid, and at the lower part of the neck passes beneath that muscle to open into the termination of the external jugular or into the sub-clavian vein. This vein varies considerably in size.

Most frequently there are two anterior jugulars, a right and left, but occasionally only one. This vein receives some laryngeal veins, and occasionally an inferior thyroid vein. Just above the sternum the two anterior jugular veins communicate by a transverse trunk which receives tributaries from the inferior thyroid veins. It also communicates with the internal jugular. There are no valves in this vein.

The Internal Jugular Vein

The internal jugular vein collects the blood from the interior of the cranium, from the superficial parts of the face, and from the neck. It commences just external to the jugular foramen in the base of the skull, being formed by the coalescence of the lateral and inferior petrosal sinuses. At its origin it is somewhat dilated, and this dilation is called the sinus (or gulf) of the internal jugular vein. It runs down the side of the neck in a vertical direction, lying at first on the outer side of the internal carotid, and then on the outer side of the common carotid, and at the root of the neck unites with the sub-clavian vein to form the vena innominata. The internal jugular vein, at its commencement, lies upon the rectus lateralis behind, and at the outer side of the internal carotid and the nerves passing through the jugular foramen, lower down the vein and artery lie upon the same plane.

At the root of the neck the vein of the right side is situated a little distance from the artery, on the left side it usually lies over the artery at its lower part.

The right internal jugular vein crosses the first part of the sub-clavian artery. The vein is of considerable size, but varies in different individuals, the left one being usually the smaller. It is provided with a pair of valves which are placed at its point of termination, or from one half to three-quarters of an inch above it.

Tributaries

This vein receives in its course the facial, lingual, pharyngeal, superior and middle

thyroid veins and sometimes the occipital. At its point of junction with the branch common to the temporal and facial veins it becomes greatly increased in size.

The lingual veins commence on the dorsum, sides, and under surface of the tongue, and, passing backward, following the course of the lingual artery and its branches, terminate in the internal jugular.

Sometimes the ranine vein, which is a branch of considerable size commencing below the tip of the tongue, joins the lingual. Generally, however, it passes backward, crosses the hyo-glossus muscle in company with the hypoglossal nerve and joins the facial.

The pharyngeal vein commences in a minute plexus, the pharyngeal, at the back part and sides of the pharynx, and after receiving meningeal tributaries and the vidian and sphenopalatine veins, terminates in the internal jugular. It occasionally opens into the facial, lingual, or superior thyroid vein.

The superior thyroid vein commences in the substance and on the surface of the thyroid gland by tributaries corresponding with the branches of the superior thyroid artery, and terminates in the upper part of the internal jugular vein.

The middle thyroid vein collects the blood from the lower part of the lateral lobe of the thyroid gland, and being joined by some veins from the larynx and trachea, terminates in the lower part of the internal jugular vein.

The vertebral vein commences in the occipital region by numerous small tributaries from the deep muscles at the upper and back part of the neck, passes outward and enters the foramen in the transverse process of the atlas, and descends by the side of the vertebral artery in the canal formed by the transverse process of the cervical vertebrae. Emerging from the foramen in the transverse process of the sixth cervical, it terminates at the root of the neck in the back part of the innominate vein near its origin, its mouth being guarded by a pair of valves. On the right side it crosses the first part of the sub-clavian artery. This vein in the lower part of its course occasionally divides into two branches, one of which emerges with the artery at the sixth cervical vertebra, the other escapes through the foramen in the seventh cervical.

Tributaries

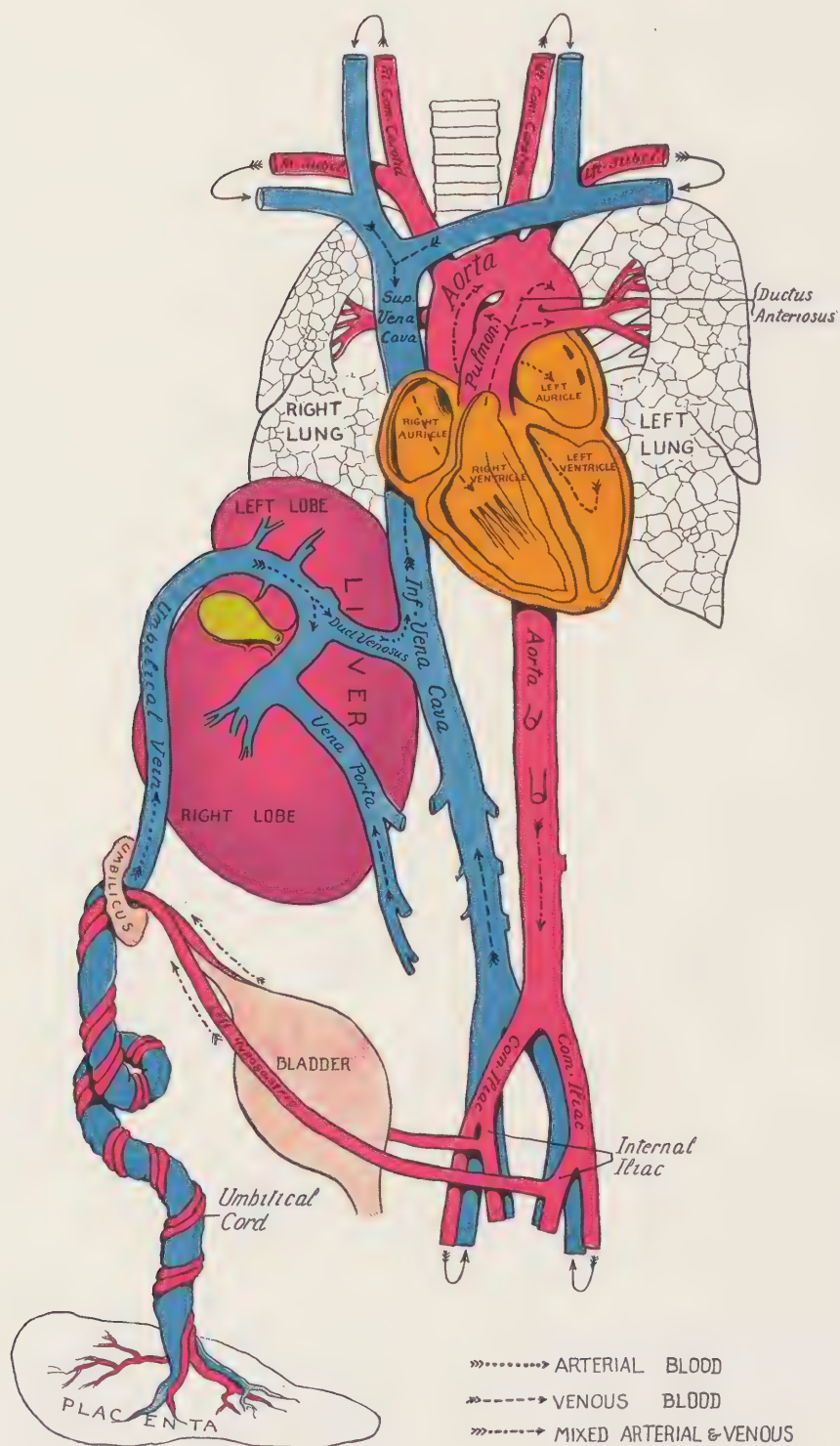
The vertebral vein receives in its course a vein from the inside of the skull through the posterior condyloid foramen, muscular veins from the muscles in the prevertebral region, dorsi spinal veins from the back part of the cervical portion of the spine, meningeal rachidian veins from the interior of the spinal canal, the ascending and deep cervical veins, and close to its termination it is joined by a small vein from the first intercostal space, which accompanies the superior intercostal artery.

It will be noticed that the vertebral vein drains a very different region from that which is supplied by its corresponding artery.

The ascending cervical vein commences in a plexus around the transverse process of the upper cervical vertebrae, descends in company with the ascending cervical artery between the scalenus anticus and rectus capitis anticus major muscles, and opens into the vertebral vein just before its termination.

(Continued on Page 66)

Plate No. 28. THE FOETAL CIRCULATION



The above illustration is a faithful reproduction in colors of the foetal circulation. The umbilical vein, vena porta, superior and inferior vena cava and branches are printed in blue. The aorta, pulmonary branches, as well as the liver, are all printed in red. The heart in yellow. The arrows are so arranged that they clearly illustrate the flow of the blood from one set of vessels into the others, thus establishing a circulation known as the foetal circulation. The lungs, bladder and placenta are clearly marked so that their relation is established.

Plate No. 28. THE FOETAL CIRCULATION

This colored plate of the foetal circulation clearly shows the manner of distribution of the blood during life, and the blood vessels that carry the preserving solution to the various parts of the body when embalming is resorted to. The illustration is a faithful reproduction in colors of the foetal circulation. The umbilical vein, vena porta, superior and inferior vena cava and branches are printed in blue. The aorta and pulmonary, as well as the liver are all printed in red. The heart is printed in yellow. The arrows are so arranged that they clearly illustrate the flow of blood from one set of vessels into the others, thus establishing a circulation known as the foetal circulation. The lungs, bladder and placenta are clearly marked so that their relation is established.

The following description of the foetal circulation will permit the reader to readily understand the passage of the preserving solution injected into any arterial branch as well as that injected into the umbilical artery.

The blood destined for the nutrition of the foetus is carried from the placenta to the foetus, along the umbilical cord, by the umbilical vein. The umbilical vein enters the abdomen at the umbilicus, and passes upward along the free margin of the suspensory ligament of the liver to the under surface of that organ, where it gives off two or three branches to the left lobe, one of which is of large size, and others to the lobus quadratus and lobulus Spigelii. At the transverse fissure it divides into two branches; of these, the larger is joined by the portal vein and enters the right lobe; the smaller branch continues onward, under the name of ductus venosus, and joins the left hepatic vein at the point of junction of that vessel with the inferior vena cava. The blood, therefore, which traverses the umbilical vein reaches the inferior vena cava in three different ways; the greater quantity circulates through the liver with the portal venous blood before entering the vena cava by the hepatic veins; some enters the liver directly, and is also returned to the inferior vena cava by the hepatic veins; the smaller quantity passes directly into the vena cava by the junction of the ductus venosus with the left hepatic vein. In the inferior vena cava the blood carried by the ductus venosus and hepatic veins becomes mixed with that returning from the lower extremities and wall of the abdomen.

It enters the right auricle, and, guided by the Eustachian valve, passes through the foramen ovale into the left auricle, where it becomes mixed with a small quantity of blood returned from the lungs by the pulmonary veins. From the left auricle it passes into the left ventricle, and from the left ventricle into the aorta, by means of which it is distributed almost entirely to the head and upper extremities, a small quantity being probably carried into the descending aorta. From the head and upper extremities the blood is returned by the branches of the superior vena cava to the right auricle, where it becomes mixed with a small portion of the blood from the inferior vena cava. From the right auricle it descends over the Eustachian valve into the right ventricle, and from the right ventricle passes into the pulmonary artery. The lungs of the foetus being solid and almost impervious, only a small quantity of blood of the pulmonary artery is distributed to them by the right and left pulmonary arteries, and is returned by the pulmonary veins to the left auricle; the greater part passes through the ductus arteriosus into the commencement of the descending aorta, where it becomes mixed

with a small quantity of blood transmitted by the left ventricle into the aorta.

Along this vessel it descends to supply the lower extremities and viscera of the abdomen and pelvis, the chief portion being, however, conveyed by the umbilical arteries to the placenta. From the above description of the circulation of the blood in the foetus it will be seen that the placenta serves the double purpose of a respiratory and nutritive organ, receiving the venous blood from the foetus, and returning it again re-oxygenated and charged with additional nutritive material. That nearly the whole of the blood of the umbilical vein traverses the liver before entering the inferior vena cava, hence the large size of this organ, especially at an early period of foetal life.

That the right auricle is the point of meeting of a double current, the blood in the inferior vena cava being guided by the Eustachian valve into the left auricle, while that in the superior vena cava descends into the right ventricle. At an early period of foetal life it is highly probable that the two streams are quite distinct, for the inferior vena cava opens almost directly into the left auricle, and the Eustachian valve would exclude the current along the vein from entering the right ventricle. At a later period, as the separation between the two auricles becomes more distinct, it seems probable that some mixture of the two streams must take place. The blood carried from the placenta to the foetus by the umbilical vein, mixed with the blood from the inferior vena cava, passes almost directly to the arch of the aorta, and is distributed by the branches of that vessel to the head and upper extremities, hence the large size and perfect development of those parts at birth.

The blood contained in the descending aorta chiefly derived from that which has already circulated through the head and upper limbs, together with a small quantity from the left ventricle, is distributed to the lower extremities; hence the small size and imperfect development of these parts at birth. By consulting the colored supplement these facts can easily be seen and clearly understood by the reader.

Changes in the Vascular System at Birth

At birth, when respiration is established, an increased amount of blood from the pulmonary artery passes through the lungs, which now perform their function as respiratory organs, at the same time the placental circulation is cut off. The foramen ovale becomes gradually closed by about the tenth day after birth; the valvular fold above mentioned becomes adherent to the margins of the foramen for the greater part of its circumference, but above a slit-like opening is left between the two auricles which sometimes remains persistent. The ductus arteriosus beings to contract immediately after respiration is established, becomes completely closed from the fourth to the tenth day, and ultimately degenerates into an impervious cord which serves to connect the left pulmonary artery to the descending aorta. Of the umbilical or hypogastric arteries, which are seen following the umbilical cord, the portion continued on to the bladder from the trunk of the corresponding internal iliac remains previous as to superior vesical artery, and the part between the fundus of the bladder and the umbilicus becomes obliterated between the second and fifth days after birth, and projects into the peritoneal sac so as to form the two fossae of the peritoneum. The umbilical vein and ductus venosus become completely obliterated between the second and fifth days after birth,

and ultimately dwindle to fibrous cords, the former becoming the round ligament of the liver, the latter the fibrous cord, which in the adult may be traced along the fissure of the ductus venosus.

Peculiarities in the Vascular System of the Foetus

The chief peculiarities in the heart of the foetus are the direct communication between the two auricles through the foramen ovale and the large size of the Eustachian valve. At an early period of foetal life the auricular portion of the heart is larger than the ventricular; the right auricle being more capacious than the left; but toward birth the ventricular portion becomes the larger. The thickness of both ventricles is at first about equal, but toward birth the left becomes much the thicker of the two. The foramen ovale is situated at the lower and back part of the septum auricularum, forming a communication between the auricles. It remains as a free oval opening from the time of the formation of the auricular septum (about the eighth week) until the middle period of foetal life. About this period a fold grows up from the posterior wall of the auricle to the left of the foramen ovale, and advances over the opening so as to form a sort of valve, which allows the blood to pass only from the right to the left auricle, and not in the opposite direction.

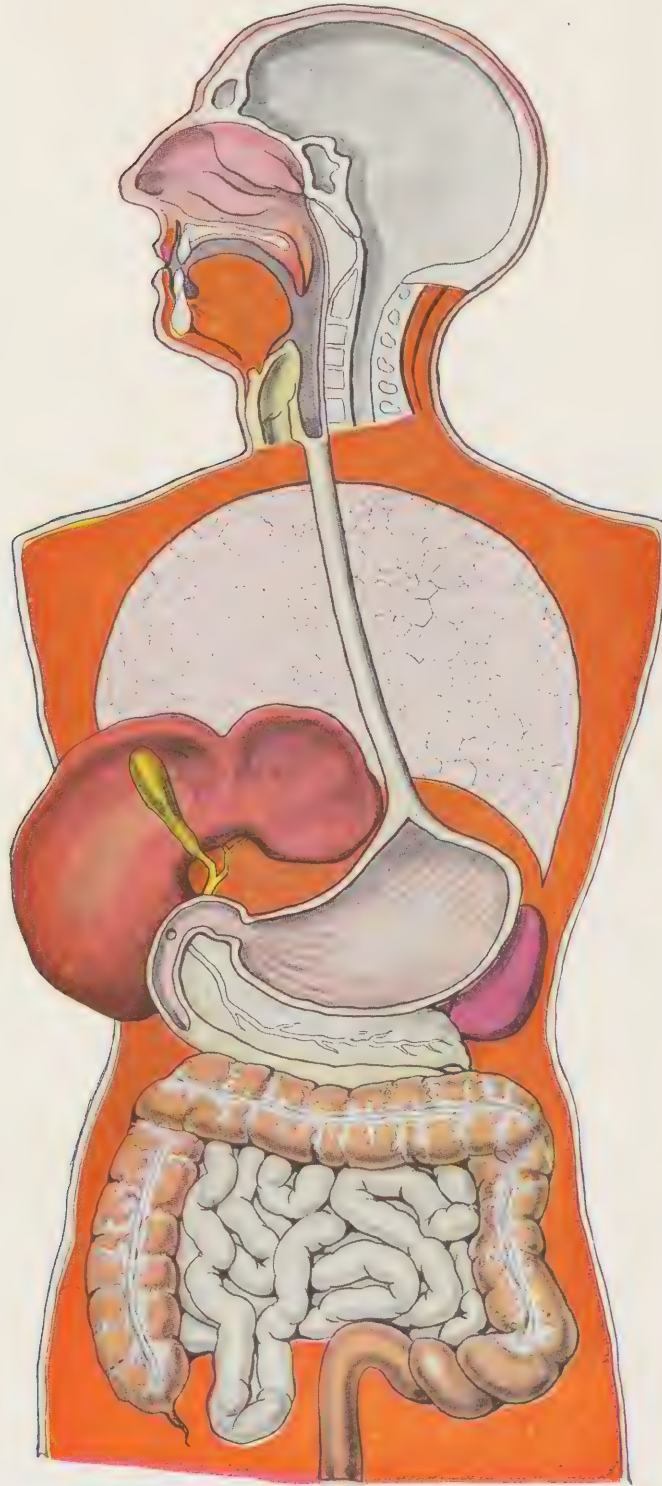
The Eustachian valve is developed from the anterior border of the inferior vena cava at its entrance into the auricle. It is directed upward on the left side of the opening of this vein, and serves to direct the blood from the inferior vena cava through the foramen ovale into the left auricle. The peculiarities in the arterial system of the foetus are the communication between the pulmonary artery and the descending aorta by means of the ductus arteriosus and the communication between the internal iliac arteries and the placenta by means of the umbilical arteries.

The ductus arteriosus is a short tube about half an inch in length at birth, and of the diameter of a goose-quill. In the early condition it forms the continuation of the pulmonary artery, and opens into the descending aorta just below the origin of the left subclavian artery, and so conducts the chief part of the blood from the right ventricle into this vessel. When the branches of the pulmonary artery have become larger relatively to the ductus arteriosus, the latter is chiefly connected to the left pulmonary artery, and the fibrous cord, which is all that remains of the ductus arteriosus in later life, and will be found attached to the root of that vessel.

The umbilical or hypogastric arteries arise from the internal iliacs, in addition to the branches given off from these vessels in the adult. Ascending along the sides of the bladder to its fundus, they pass out of the abdomen at the umbilicus, and are continued along the umbilical cord to the placenta, coiling around the umbilical vein, which is plainly illustrated on the colored anatomical supplement.

They return the blood to the placenta, after it has circulated in the system of the foetus. The peculiarity in the venous system of the foetus is the communication established between the placenta and the liver and portal vein through the umbilical vein, and the inferior vena cava through the ductus venosus. If the axillary artery of a foetus is injected with preserving fluid, the fluid will escape with the umbilical arteries if the umbilical cord is not tied, and if the umbilical arteries are injected directly, the fluid will circulate to all parts of the foetus.

Plate No. 29. ORGANS OF DIGESTION



The apparatus for the digestion of food consists of the alimentary canal and of certain accessory organs. The above chart shows the course and formation of these parts. As they have not been marked with letters or names, a description of their various portions will be found in this issue of The Casket. The cavities of the head are also plainly drawn so as to give the reader a clear understanding of their location. The position of the abdominal viscera will assist the reader in understanding the necessity for irrigating the cavities with preserving solution.

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This colored plate shows the course and formation of these parts. As they have not been marked with letters or names, a description of their various portions will be given. The cavities of the head are also plainly drawn so as to give the reader a clear understanding of their location. The position of the abdominal viscera will assist the reader in understanding the necessity for irrigating the cavities and their hollow organs with preserving solutions.

The alimentary canal is a musculo-membranous tube, about thirty-two feet in length, extending from the mouth to the anus, and lined throughout its extent with mucous membrane. It has received different names in various portions of its course; at its commencement, the mouth (colored black), we find provision made for the mechanical division of the food (mastication), and for its admixture with a fluid secreted by the salivary glands (insalivation); beyond this are the organs of deglutition the pharynx (colored black) and the oesophagus, (the tube in white passing from the neck to the upper end of the stomach), which conveys the food into that part of the alimentary canal (the stomach) in which the principal chemical changes occur, and in which the reduction and solution of the food takes place. In the small intestines the nutritive principles of the food (the chyle) are separated, by its admixture with the bile and pancreatic fluid, from that portion which passes into the large intestine, most of which is expelled from the system as waste matter.

Summing up, the alimentary canal may be divided as follows:

Mouth, pharynx, oesophagus, stomach.

Small intestine—Duodenum, jejunum, ileum.

Large intestine—Caecum, colon, rectum.

Accessory Organs

Teeth. Salivary glands—Parotid, submaxillary, sublingual.

Liver, pancreas, spleen.

The Mouth (oral or buccal cavity) is the vestibule to the alimentary canal. The mucous membrane lining the mouth is continuous with the integument at the free margin of the lips and with the mucous lining of the fauces behind.

The lips are two fleshy folds which surround the orifice of the mouth. The pharynx is that part of the alimentary canal which is placed behind the nose, mouth and larynx. The pharynx is about four and a half inches in length, and broader in the transverse than in the antero-posterior diameter, and is continuous with the oesophagus. It has seven openings communicating with it, the two posterior nares, the two eustachian tubes, the mouth, larynx and oesophagus.

The Oesophagus, or gullet, is a muscular canal, about nine inches in length, extending from the pharynx to the stomach. When empty its lumen appears as a transverse slit. It commences at the upper border of the cricoid cartilage, opposite the intervertebral disk between the fifth and sixth cervical vertebrae, descends along the front of the spine through the posterior mediastinum, passes through the diaphragm, and entering the abdomen, terminates in the cardiac orifice of the stomach opposite the tenth dorsal vertebra. The general direction of the oesophagus is vertical, but it presents two or three slight curves in its downward course. It is the narrowest part of the alimentary canal, being most contracted at its commencement and at the point where it passes through the diaphragm. The oesophagus has three coats.

The stomach is a sac-like, pear-shaped dilation of the alimentary canal placed between the oesophagus and beginning of the

small intestine. Its large end is directed above and to the left, to the diaphragm, its small end below and to the right. The beginning of the stomach or its mouth is the cardiac opening, which passes from the oesophagus like an inverted funnel (see illustration) without visible external limit. On the inner surface a definite line is seen between the oesophagus and cardia. At the right the body of the stomach gradually contracts toward its duodenal end. Then follows a second smaller part of the stomach whose form and size vary. Usually the antrum appears as a double pouch, the flatter one is higher and extends from the lesser curvature to the beginning of the duodenum. The division between the stomach and intestine is marked externally by a circular constriction, and more deeply by a muscular ring (sphincter pyloricus), and internally by a corresponding projection of mucous membrane called valvula pylorica or pylorus. The size of the stomach varies according to age, sex, individual, and degree of distention. The weight of the freed stomach is about four and a half ounces. Its normal capacity in the adult male is about four pints.

The stomach lies in the epigastric region and left hypochondrium, rarely in the right hypochondrium, about five-sixths to the left of the median line, and one-sixth to the right. The only part belonging to the right half includes a very small portion of the pylorus. The stomach then lies under the diaphragm and liver, above the jejunum, ileum, and transverse colon, extending its greater part into the left hypochondrium and smaller part into the epigastrium between the spleen on the left and gall bladder on the right. It does not lie transversely nor yet vertically. The empty stomach may hang nearly vertically. If the small intestines are distended it may be transverse, or if rigor mortis be rapid it may be cylindrical, especially below.

The stomach is bounded above by the diaphragm, on the left by the cartilaginous ends of the seventh, eighth and ninth ribs, on the right by the anterior margin of the liver, and below by the transverse colon. This is the only part of the stomach to be actually seen (anterior wall) when the subject is opened. The stomach is usually filled with either liquids or solid undigested food, or it may only contain a small amount of either. However, these substances undergo fermentative changes which cause distention of the stomach and cause what is usually termed purging from the mouth and nose.

The intestinal canal, in the form of a curved tube, passes uninterruptedly from the pyorus to the anus. It has a remarkable length of about six times the height of its possessor, though in the adult it may be independent of the age, height, or weight. The wall of the intestine offers throughout a serous, muscular and mucous coat presenting many modifications, by which the upper four-fifths is distinguished as small intestine and the lower fifth as large intestine.

By the term, small intestine, is understood the part of the alimentary canal extending from the pylorus to the ileocaecal valve. Its average length is about twenty-five feet, but there are cases on record where it has been found to be 34 and 8 feet, these being extremes. Its circumference decreases from the stomach to the large intestine, and its capacity when inflated and dried is said to be 15 pints. The wall of the ileum is so thin and translucent that a newspaper may be read through it. The small intestine is divided into three parts as follows: Duodenum (12 fingers intestine); Jejunum (empty intestine); Ileum (curved or twisted intestine).

The large intestine extends from the termination of the ileum to the anal orifice. It differs from the small intestine in its larger size, more fixed position and saccular

form. It is about five or six feet in length. Its capacity in moderate distention averages twenty-two ounces per foot, or about eight pints for the entire length. Its circumference decreases from beginning to end, except at the ampulla of the rectum. By the accumulation of faecal matter or gas the colon may be distended to double its normal size.

Sometimes in the fresh body of a robust suicide the descending colon or sigmoid flexure or even part of transverse colon may be contracted to the thickness of the thumb. The tube is hard and can scarcely be opened by inflation. In the greater part of the colon its external surface is very uneven from the presence of pouches or saccules, protrusions arranged in rows of three columns. These are separated by three ligamentous tapes about the width of the little finger, which can easily be seen on the colored chart.

In its course the large intestine describes a horseshoe shaped arch which surrounds the convolutions of the small intestine. It begins in a blind sac in the right iliac fossa, ascends along the right posterior abdominal wall to the right hypochondrium, where it is in contact with the under surface of the liver. It here bends to the left, and takes a transverse somewhat ascending course to the spleen. In the left hypochondrium it bends again and descends along the left posterior abdominal wall to the left iliac fossa, then becomes convoluted as the sigmoid flexure; it finally enters the pelvis and descends as the rectus along its posterior wall to the anus.

The liver (which has been raised so as to expose the gall bladder) is a gland intended for the secretion of sugar and bile, remarkable for its size, equaling that of all other glands put together. It is situated below the diaphragm which separates it from the lungs and heart, above the stomach, duodenum, transverse colon, and small intestines which form a sort of pillow, and behind are the right false ribs which protect it.

The average weight of the liver is about four and a half pounds, but if it contains much blood it may weigh more. The liver contains five lobes although one is very small.

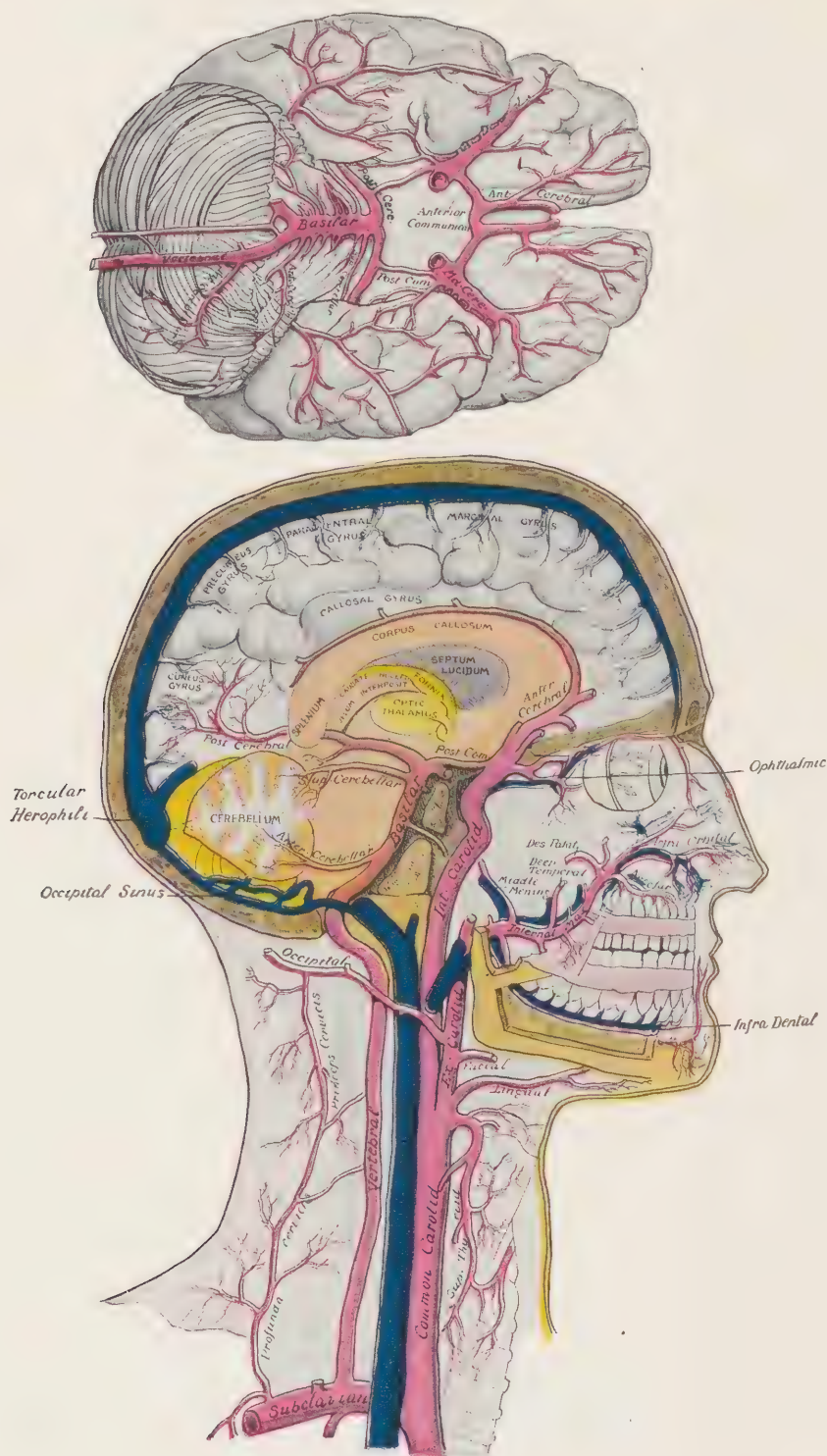
The pancreas of the abdominal salivary gland is similar to the salivary glands in structure, though softer and less compact. It is long and lies transversely across the posterior wall of the abdomen. It lies deep in the epigastrium behind the stomach, between the duodenum on the right and the spleen on the left. In color the pancreas is gravis white in the intervals of digestion, turning to a rosy hue during secretion. It contains pancreatic juice which quickly ferments, thereby contributing to putrefactive changes in the abdominal cavity.

The spleen is the largest and most important ductless gland. It is probably related to the vascular system, yet its anatomical relations to the stomach and physiological relation to the liver, may allow it to be described as an accessory to the digestive tract. It is placed deep in the left hypochondrium, between the fundus of the stomach and diaphragm, above the descending colon. No organ varies more in volume than the spleen. In children it is relatively well developed. In old age it is usually atrophied. It varies with the same individual, with sex, degree of fullness of portal vein, state of health or of disease, and with the influence of certain drugs. It is hypotrophied in all infectious diseases and in all depending upon malarial poison or leukaemia. It may become so large as to completely reach the pelvis and weigh many pounds. If the spleen is filled with blood it usually weighs about 7 ounces, and its color after death is a dark purple to a greyish red due to the presence of venous blood, which in turn contributes to the rapidity with which putrefactive fermentation takes place in this body. The spleen can be seen lying to the left of the stomach and is colored a dark red, same as that of the liver.

The stomach, spleen, pancreas, liver, large and small intestines and lungs containing mucous and juices undergo rapid putrefactive fermentation, resulting in the production of gas which distends the parts and pressing on the hollow organs causes a discharge, usually from the mouth and nose. The irrigation of these parts with preserving preparations is of the utmost necessity.

The colored plate is intended to give the reader a concise idea of the relative position of the organs and glands contained in the trunk of the body.

Plate No. 30. CIRCULATION OF THE HEAD AND BRAIN



The above anatomical plate, that accompanies the December issue of *The Casket*, plainly shows the arteries and veins of the head as well as the arteries of the brain. Two views are presented so as to give a clear idea of their relation to each other. The arteries are printed in red while the veins are in blue. The various branches that form the circle of Willis are presented from a lateral angle as well as from a direct view. The longitudinal sinus is plainly seen, giving the reader a clear idea of how the blood is drained from the interior of the head. The left hemisphere of the brain is faithfully illustrated. A study of the above illustrations will give the reader a good idea of how the preserving solutions are distributed to the parts.

Plate No. 30. CIRCULATION OF THE HEAD AND BRAIN

This colored plate plainly shows the arteries and veins of the head as well as the arteries of the brain. Two veins are presented to give a clear idea of their relation to each other. The arteries are printed in red while the veins are in blue. Branches that form the Circle of Willis are presented from a lateral and direct perspective. The longitudinal and occipital sinus is plainly seen, giving the reader a clear idea of how the blood is drained from the interior of the head. The left hemisphere of the brain is faithfully illustrated. A study of the plate will convey to the reader a good idea of how the preserving solution is distributed to the various parts of the head, neck, and brain. The importance of this colored anatomical chart cannot be overestimated, for it is by means of these blood vessels that the natural appearance of the head and neck, so much desired by progressive embalmers, is accomplished. By following the arterial branches, accompanied by a brief description of each, the reader will be able to more clearly understand how the preserving fluid is distributed to each minute part. Following the common carotid artery we see it passing upwards obliquely from behind the sterno-clavicular articulation to a level with the upper border of the thyroid cartilage, where it divides into the external and internal carotid; these names being derived from the distribution of the arteries to the external parts of the head and face and to the internal parts of the cranium and orbit respectively. As the external part of the head has been removed, only a part of the external carotid artery is visible. At the lower part of the neck the common carotid artery is very deeply seated, but in the upper part of its course, near its termination, it is more superficial. We then follow the internal carotid artery.

Internal Carotid Artery

The internal carotid artery supplies the anterior part of the brain, the eye, and its appendages, and sends branches to the forehead and nose. Its size in the adult is equal to that of the external carotid, though in the child it is larger than that vessel. It is remarkable for the number of curvatures that it presents in different parts of its course. In the first curve which this artery describes, known as the cervical portion it occasionally presents one or two flexures near the base of the skull, whilst through the rest of its extent it describes a double curvature which resembles the italic letter S placed horizontally. These curvatures most probably diminish the velocity of the current of blood, by increasing the extent of surface over which it moves and adding to the amount of impediment produced from friction. The remaining three portions of this artery may be divided into the petrous, cavernous and cerebral.

Cervical Portion of Internal Carotid Artery

The cervical portion of the internal carotid artery commences at the bifurcation of the common carotid, opposite the upper border of the thyroid cartilage, and runs perpendicularly upward, in front of the transverse process of the three upper cervical vertebrae, to the carotid canal in the petrous portion of the temporal bone. It is superficial at its commencement, being contained in the superior carotid triangle, and lying on the same level as the external carotid, it then passes beneath the parotid gland, being

crossed by the external carotid and occipital arteries.

Petrous Portion of Internal Carotid Artery

When the internal carotid artery enters the canal in the petrous portion of the temporal bone, it first ascends a short distance, then curves forward and inward, and again ascends as it leaves the canal to enter the cavity of the skull. In this canal the artery lies at first anterior to the tympanum. It is separated from the bony wall of the carotid canal by a prolongation of dura mater, and is surrounded by filaments of the carotid plexus.

Cavernous Portion of Internal Carotid Artery

The internal carotid artery in this part of its course is situated between the layers of the dura mater forming the cavernous sinus, but covered by the lining membrane of the sinus. It at first ascends to the posterior clinoid process, then passes forward by the side of the body of the sphenoid bone, and again curves upward on the inner side of the anterior clinoid process, and perforates the dura mater forming the roof of the sinus.

Cerebral Portion of Internal Carotid Artery

Having perforated the dura mater on the inner side of the anterior clinoid process, the internal carotid enters the inner extremity of the fissure of Sylvius, where it gives off its terminal or cerebral branches. This portion of the artery has the optic nerve on its inner side.

Another important branch given off by the internal carotid and plainly illustrated on the colored anatomical chart, is the ophthalmic artery which is described below.

Ophthalmic Artery

The ophthalmic artery arises from the internal carotid artery, just as that vessel is emerging from the cavernous sinus, on the inner side of the anterior clinoid process, and enters the orbit through the optic foramen, below and on the outer side of the optic nerve. It then passes over the nerve to the inner wall of the orbit, and thence horizontally forward, beneath the lower border of the superior oblique muscle to a point behind the internal angular process of the frontal bone, where it divides into two terminal branches, the frontal and nasal.

By consulting the colored plate we see the first section of the subclavian artery giving off two important branches which are of considerable interest to the embalmer, namely the vertebral and thyroid axis, the latter being represented by a short stump, but the vertebral is shown in its entirety. As the vertebral is the most important of the two, it may be described as arising from the upper and back part of the first portion of the subclavian, and, passing upward, enters the foramen in the transverse process of the sixth cervical vertebra, and ascends through the foramina in the transverse processes of all the vertebrae above this. Above the upper border of the axis it inclines outward and upward to the foramen in the transverse process of the atlas, through which it passes; it then winds backward behind its articular process, runs in a deep groove on the upper surface of the posterior arch of this bone, and, passing beneath the posterior occipito-atlantal ligament, pierces the dura mater and enters the skull through the foramen magnum. It then passes forward and upward to the front of the medulla

oblongata, and unites with the vertebral of the opposite side at the lower border of the pons Varolii to form the basilar artery, which sends out branches which contribute to the formation of the Circle of Willis.

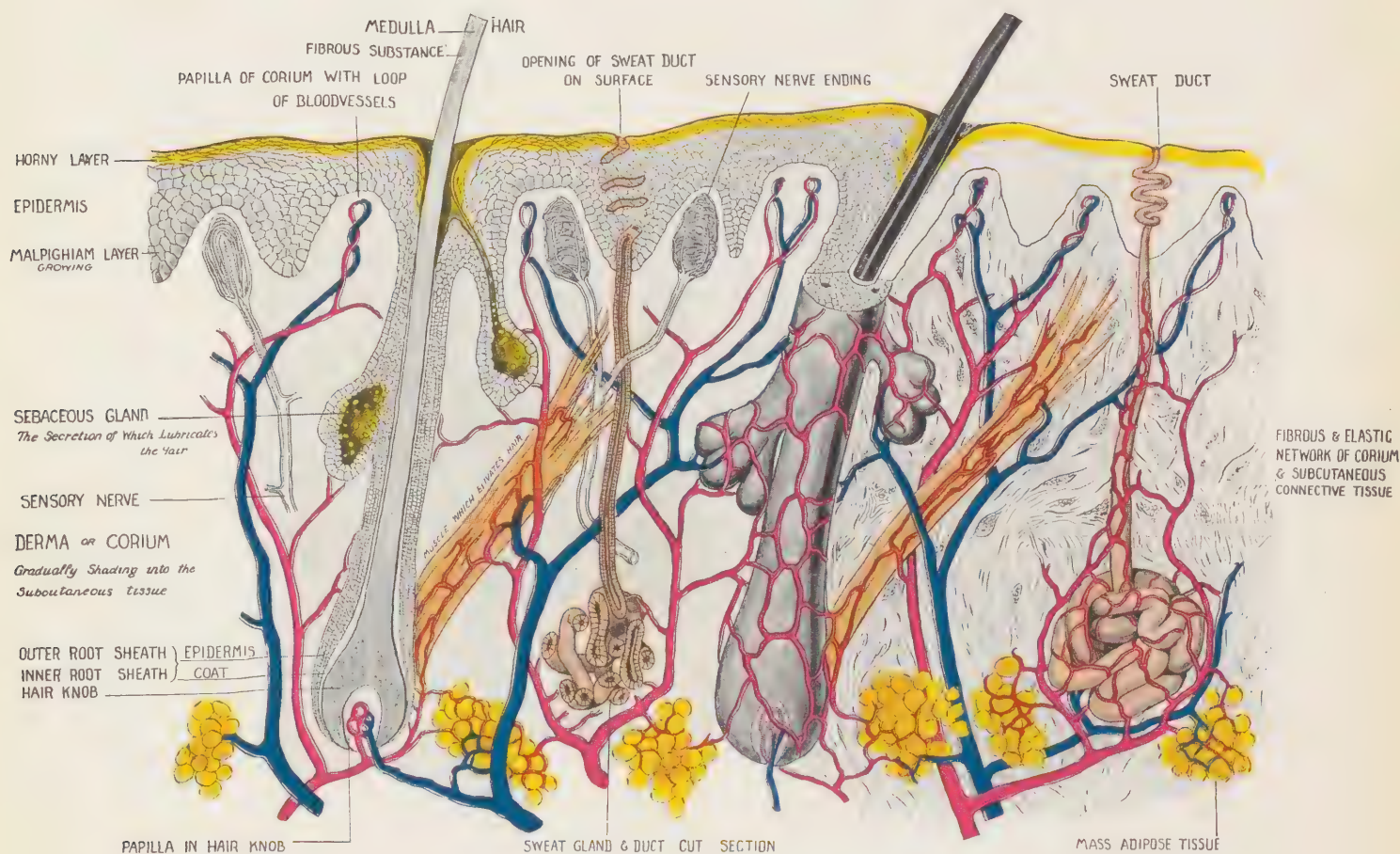
Circle of Willis

By consulting the upper portion of the colored anatomical chart the brain and various arterial branches constituting the Circle of Willis will be seen. The remarkable anastomosis which exists between the branches of the internal carotid and vertebral arteries at the base of the brain constitutes the Circle of Willis. It is formed, in front, by the anterior cerebral arteries, branches of the internal carotid, which are connected to each other by the anterior communicating; behind, by the two posterior cerebrals, branches of the basilar, which are connected on each side with the internal carotid by the posterior communicating arteries. It is by this anastomosis that the cerebral circulation is equalized, and provision made for effectually carrying it on if one or more of the branches are obliterated.

We may now make a survey of the venous branches that are printed in blue on the anatomical chart. The external jugular vein which is not featured on the anatomical chart, receives the greater part of the blood from the exterior of the cranium and deep parts of the face. The internal jugular vein, which is featured on the anatomical chart, collects the blood from the interior of the cranium, and superficial parts of the face and neck. The superior longitudinal sinus can be plainly seen, and occupies the attached portion of the falx cerebri. Commencing as it does at the foramen caecum, through which it constantly communicates by a small branch with the veins of the nasal fossae, it runs from before backward, and terminates by opening into the torcular Herophili, which is plainly marked. The sinus is narrow in front, and gradually increases in size as it passes backward. This sinus receives the superior cerebral veins, numerous veins from the diploe and dura mater, and, at the posterior extremity receive veins from the pericranium. The torcular Herophili is the dilated extremity of the superior longitudinal sinus. It is of irregular form, and is lodged on one side of the internal occipital protuberance. From it the lateral sinus of the side to which it is deflected is derived. It receives the blood from the occipital sinus. The occipital is the smallest of the cranial sinuses.

The internal jugular vein collects the blood from the interior of the cranium, from the superficial parts of the face and neck. It commences just external to the jugular foramen, at the base of the skull, being formed by the coalescence of the lateral and inferior petrosal sinuses. At its origin it is somewhat dilated, and this dilatation is called the sinus, or gulf, of the internal jugular vein. It runs down the side of the neck in a vertical direction, lying at first on the outer side of the internal carotid, and then on the outer side of the common carotid, and at the root of the neck unites with the subclavian vein to form the innominate vein. The internal jugular vein is provided with a pair of valves, which are placed at its point of termination or from half to three quarters of an inch above it. These valves do not oppose the passage of fluid should it be injected into the veins, as is the case in other venous branches.

Plate No. 31. THE HUMAN SKIN AND ITS APPENDAGES



The above colored illustration shows the human skin and its appendages, magnified many thousands of diameters. This chart should be of immense value to the embalmer in clearly showing the course of the fluid through the capillary loops, and the manner of its distribution to the epidermis. The outer or horny layer of the skin is shown in the yellow color, under the horny layer, the epidermis or cuticle is seen, then the derma or cutis, then the subcutaneous connective tissue. The numerous capillary loops here illustrated convey the thorough manner in which the blood is distributed during life, and the preserving solution after death.

Plate No. 31. THE HUMAN SKIN AND ITS APPENDAGES

This colored plate illustrates in colors the various layers of the skin, as well as the plexus of blood vessels that play such an important part in the distribution of preserving solution to the surface of the body after death.

The skin is the principal seat of the sense of touch, and may be regarded as a covering for the protection of the deeper tissues. It is also an important excretory and absorbing organ. It consists principally of a layer of vascular connective tissue, named the derma, corium, or cutis vera, and an external covering of epithelium, termed the epidermis or cuticle. On the surface of the former layer are the sensitive papillae; and within, or imbedded beneath it, are certain organs with special functions; namely, the sweat glands, hair follicles, and sebaceous glands.

Epidermis or Cuticle

The epidermis or cuticle (scarf skin) is an epithelial structure belonging to the class of stratified epithelium. It is accurately moulded on the papillary layer of the derma. It forms a defensive covering to the surface of the true skin, and limits the evaporation of watery vapor from its free surface. When the epidermis is detached or abraded as in putrefaction or shaving of the dead, evaporation quickly takes place and desiccation quickly follows. It varies in thickness in different parts. In some parts, as in the palms of the hands and soles of the feet, it is thick, hard, and horny in texture. This may be partly due to the fact that these parts are exposed to intermittent pressure, but that this is not the only cause is proved by the fact that the condition exists to a very considerable extent at birth. The more superficial layers of cells, called the horny layer, may be separated by maceration from the deeper layers, which are called the rete mucosum, and which consists of several layers of differently shaped cells. The free surface of the epidermis is marked by a net work of linear furrows of variable size, marking the surface into a number of spaces of polygonal or lozenge shaped form which are plainly seen on the colored supplement. Some of these furrows are large, as opposite the flexures of the joints, and correspond to the folds in the derma produced by their movement. In other locations, as upon the back of the hand, they are exceedingly fine, and intersect one another at various angles; upon the palmar surface of the hand and fingers and upon the sole of the foot these lines are very distinct and are disposed in curves. They depend upon the large size and peculiar arrangement of the papillae upon which the epidermis is placed.

The deep surface of the epidermis is accurately moulded upon the papillary layer of the derma, each papilla being invested by its epidermic sheath; so that when this layer is removed by maceration or putrefactive changes, it presents on its under surface a number of pits or depressions corresponding to the elevations in the papillae, as well as the ridges left in the intervals between them. Fine tubular prolongations are continued from this layer into the ducts of the sudoriferous and sebaceous glands. In structure, the epidermis consists of several layers of epithelial cells agglutinated together and having a laminated arrangement. These several layers may be described as composed of four different strata from within outward as follows. The

rete Malpighii, composed of several layers of epithelial cells, of which the deepest layer is elongated in figure and placed perpendicularly on the surface of the corium, their lower ends being denticulate, to fit into corresponding denticulations of the true skin; while the succeeding laminae consists of cells of a more rounded or polyhedral form, the contents of which are soft, opaque, granular, and soluble in acetic acid. They are often marked on their surfaces with ridges and furrows, and are covered with numerous fibrils, which connect the surfaces of the cells and are known as prickles cells.

Immediately superficial to these is a single layer of flattened, spindle shaped cells, the granular layer, which contain granules that become deeply stained in haematoxylin, and are composed of a substance called eleidin. They are supposed to be cells in a transitional stage between the protoplasmic cells of the rete Malpighii and the horny cells of the superficial layers. Above this layer the cells become indistinct, and appear, in sections, to form a homogeneous or dimly striated membrane composed of closely packed scales, in which traces of a flattened nucleus may be found. It is called the stratum lucidum. As these cells successively approach the surface by the development of fresh layers from beneath, they assume a flattened form from the evaporation of their fluid contents, and consist of many layers of horny epithelial scales in which no nucleus is discernible, forming the stratum corneum. These cells apparently become changed in their chemical composition, as they are now unaffected by acetic acid. The deepest layer of the rete Malpighii is separated from the papillae by an apparently homogeneous basement membrane, which is most distinctly brought into view in specimens prepared with chloride of gold. This, according to Klein, is merely the deepest portion of the epithelium, and is made up of the basis of the individual cells, which have undergone a chemical and morphological alteration. The black color of the skin in the negro and the tawny color among some of the white races is due to the presence of pigment in the cells of the cuticle. This pigment is more especially distinct in the cells of the deeper layer or rete mucosum, and is similar to that found in the cells of the pigmentary layer of the retina. As the cells approach the surface and desiccate, the color becomes partially lost.

The Derma, Corium, or Cutis Vera

The derma, corium, or cutis vera, is tough, flexible, and highly elastic in order to defend the parts beneath from violence. It is very thick in the palms of the hands and soles of the feet, thicker on the posterior part of the body than the front, and on the outer than the inner side of the limbs. In the eyelids it is exceedingly thin and delicate. The skin is generally thicker in the male than in the female, and in the adult than in the child. The corium consists of fibrous connective tissue, with a large admixture of elastic fibers and numerous blood vessels, lymphatics, and nerves. The fibro-areolar tissue forms the frame work of the cutis, and is differently arranged in different parts, so that it is usual to describe it as consisting of two layers, the deeper or reticular layers, and the superficial or papillary layer.

The reticular layer consists of strong interlacing fibrous bands, composed chiefly of the white variety of fibrous tissue, but con-

taining also, some fibers of the yellow elastic tissue, which vary in amount in different parts, and connective tissue corpuscles, which are often to be found flattened against the white fibrous tissue bundles. Toward the attached surface the fasciculi are large and coarse, and the areolae which are left by their interlacement are large, and occupied by adipose tissue and sweat glands. Below this the elements of the skin become gradually blended with the subcutaneous areolar tissue, which, except in a few situations, contains fat. Toward the free surface the fasciculi are much finer, and their mode of interlacing close and intricate.

The papillary layer is situated upon the free surface of the reticular layer, it consists of numerous small, highly sensitive, or vascular eminences known as the papillae, which rise perpendicularly from its surface. The papillae are conical shaped eminences, having a round or blunted extremity, occasionally divided into two or more parts and connected by a thin base with the free surface of the corium. The majority of the papillae contain loops of blood vessels, and these are known as the vascular papillae in contradistinction to others which usually possess no blood vessels, but contain tactile corpuscles.

The arteries supplying the skin form a network in the subcutaneous tissue, from which branches are given off to supply the sweat glands, the hair follicles, and the fat. Other branches are given off which form a plexus immediately beneath the corium; from this fine capillary vessels pass into the papillae, forming, in the smaller papillae, a single capillary loop, but in the larger a more or less convoluted vessel. There are numerous lymphatics supplied to the skin which form two networks, superficial and deep, communicating with each other and with those of the subcutaneous tissue by oblique branches. They originate in the cell spaces of the tissue. The nerves of the skin terminate partly in the epidermis and partly in the cutis vera. The former form a dense plexus in the superficial layer of the corium, which extends horizontally and gives off numerous fibrils; these are prolonged into the epidermis, and terminate between the cells, either in bubous, extremities or in a network; or, according to some observers, in the deep epithelial cells themselves. Other nerve fibers are supplied to the plain muscular tissues of the hair muscles and to the muscular coat of the blood vessels.

Appendages of the Skin

The appendages of the skin are the nails, the hairs, the sudoriferous and sebaceous glands of their ducts. The nails and hairs are peculiar modifications of the epidermis, consisting essentially of the same cellular structure as that tissue.

Sebaceous Glands

The sebaceous glands are small, succulated, glandular organs, lodged in the substance of the corium. They are found in most parts of the skin, but are most abundant in the skin of the scalp and face, they are also very numerous around the apertures of the nose, mouth, and external ear, but are wanting in the palms of the hands and soles of the feet. The orifices of the ducts open most frequently into the hair follicles, but occasionally upon the surface of the skin. On the nose and face the glands are large in size, distinctly lobulated, and often become much enlarged from the accumulation of pent up secretion.

Plate No. 27. SUPERIOR AND INFERIOR VEÑA CAVA AND BRANCHES

(Continued from Page 57)

The deep cervical vein accompanies the profunda cervicis artery, lying between the complexus and semispinalis colli. It commences in the sub-occipital region by communicating branches from the occipital vein and tributaries from the deep muscles at the back of the neck. It receives tributaries from the plexuses around the spinous process of the cervical vertebrae, and terminates in the lower end of the vertebral vein.

The posterior auricular vein commences upon the side of the head by a plexus which communicates with the tributaries of the temporal and occipital veins. The vein descends behind the external ear and joins the temporo maxillary vein, forming the external jugular. This vessel receives the stylo-mastoid vein and some tributaries from the back part of the external ear.

The occipital veins, generally two or three in number, commence at the back part of the vortex of the skull by a plexus, in a similar manner to the other veins.

It follows the course of the occipital artery, passing deeply beneath the muscles of the back part of the neck and terminates in the internal jugular, occasionally in the external jugular. As this vein passes across the mastoid portion of the temporal bone it receives the mastoid vein, which establishes a communication with the lateral sinus.

Subclavian Vein

The subclavian vein, the continuation of the axillary, extends from the outer margin of the first rib to the inner end of the sterno-clavicular articulation, where it unites with the internal jugular to form the innominate vein. It is in relation in front with the clavicle and subclavius muscle, behind with the subclavian artery, from which it is separated internally by the scalenus anticus and phrenic nerve; below, it rests in a depression on the first rib and upon the pleura; above, it is covered by the cervical fascia and integument.

The subclavian vein occasionally rises in the neck to a level with the third part of the sub-clavian artery. This vessel is usually provided with valves about an inch from its termination in the innominate just external to the entrance of the external jugular vein.

Tributaries

It receives the external and anterior jugular veins and a small branch from the cephalic outside the scalenus, and on the inner side of that muscle the internal jugular vein.

Innominate or Broncho-cephalic Veins

The innominate or Broncho-cephalic veins are two large trunks placed one on each side of the root of the neck, and formed by the union of the internal jugular and subclavian veins of the corresponding side. (By consulting the colored anatomical supplement it will be noticed that there are two innominate veins, but only one innominate artery).

Right Innominate Vein

The right innominate vein is a short vessel, about an inch and a half in length, which commences at the inner end of the clavicle, and passing almost vertically downward, joins with the left vena innominate just below the cartilage of the first rib, close to the right border of the sternum, to form the superior vena cava. It lies superficial and external to the innominate artery, on its right side the pleura is interposed between it and the apex of the lung. This vein at the angle of junction of the internal jugular with the subclavian receives the right vertebral vein and right lymphatic duct, and

lower down the right internal mammary, right inferior thyroid, and sometimes the right superior intercostal veins.

The Left Innominate Vein

The left innominate vein, about three inches in length and larger than the right, passes from left to right across the upper and front part of the chest, at the same time inclining downward to unite with the innominate of the opposite side, thus forming the superior vena cava.

It is in relation in front with the first portion of the sternum, from which it is separated by the sterno thyroid muscles, the thymus gland or its remains, and some loose areolar tissue. Behind, it lies across the roots of the three large arteries arising from the arch of the aorta. This vessel is joined by the left vertebral, left inferior thyroid, left internal mammary, and the left superior intercostal veins, and occasionally some thymic and pericardiac veins.

The thoracic duct empties into the left innominate vein at the angle of junction of the internal jugular and subclavian veins. There are no valves in the vena innominata.

Internal Mammary Veins

The internal mammary veins, two in number to each artery, follow the course of that vessel, and receive branches corresponding with those derived from it. The two veins on each side unite into a single trunk, which terminates in the innominate vein.

Inferior Thyroid Veins

The inferior thyroid veins, two, (often three or four) in number, arise in the venous plexus on the thyroid body, communicating with the middle and superior thyroid veins.

The left one descends in front of the trachea, behind the sterno-thyroid muscle, communicating with its fellow by transverse branches, and terminates in the left vena innominata.

The right, which occupies a position a little to the right of the median line, opens into the right vena innominata just at its junction with the superior vena cava.

These veins receive oesophageal, tracheal, and inferior laryngeal branches, and are provided with valves at their termination in the innominate veins.

The Superior Intercostal Veins

The superior intercostal veins return the blood from the upper intercostal spaces.

The right superior intercostal, much smaller than the left, closely corresponds with the superior intercostal artery, receiving the blood from the first, or first and second intercostal spaces, and, passing downward, terminates in the vena azygos major. Occasionally it opens into the right innominate vein.

The left superior intercostal is always larger than the right, but varies in size in different cases, being small when the left upper azygos vein is large, and vice versa. It is usually formed by branches from the two or three upper intercostal spaces, and, passing across the arch of the aorta, terminates in the left vena innominata.

The left bronchial vein and the left superior phrenic open into it.

The Superior Vena Cava

The superior vena cava receives the blood which is conveyed to the right auricle of the heart from the entire upper half of the body as well as the contents of the right lymphatic and thoracic ducts. It is a short trunk, varying from two inches and a half to three inches in length, formed by the junction of the two venal innominatae. It commences immediately below the cartilage

of the first rib close to the sternum on the right side, and, descending vertically, enters the pericardium about an inch and a half above the heart, and terminates in the upper part of the right auricle. At the angle of junction of the two innominate veins the right superior phrenic opens into the superior vena cava.

The Azygos Veins

The azygos veins connect the superior and inferior vanae caval supplying the place of those vessels in the part of the chest which is occupied by the heart.

The larger, or right azygos vein (azygos major), commences opposite the first or second lumbar vertebra by a branch from the right lumbar veins (the ascending lumbar) sometimes by a branch from the right venal vein or from the inferior vena cava. It enters the thorax through the aortic opening in the diaphragm, and passes along the right side of the vertebral column to the fourth dorsal vertebra, where it arches forward over the root of the right lung, and terminates in the superior vena cava just before that vessel enters the pericardium.

While passing through the aortic opening in the diaphragm it lies with the thoracic duct on the right side of the aorta, and in the thorax it lies upon the intercostal arteries, on the right side of the aorta and thoracic duct, in the posterior mediastinum.

Tributaries

It receives nine or ten lower intercostal veins of the right side, the vena azygos minor, several oesophageal, mediastinal, and pericardial veins, near its termination the right bronchial vein, and is occasionally connected with the right superior intercostal vein. A few imperfect valves are found in this vein, but its tributaries are provided with complete valves.

The intercostal veins on the left side, below the two or three upper intercostal spaces, usually form two trunks, named the left lower and left upper azygos veins.

The left lower, or smaller azygos vein (azygos minor on colored plate), commences in the lumbar region by a branch from one of the lumbar veins (ascending lumbar) or from the left renal. It passes into the thorax through the left crus of the diaphragm, and ascending on the left side of the spine as high as the eighth dorsal vertebra, passes across the column, behind the aorta and thoracic duct, to terminate in the right azygos vein.

It receives the four or five lower intercostal veins of the left side, and some cesophageal and mediastinal veins.

The left upper azygos vein varies according to the size of the left superior intercostal. It receives veins from the intercostal spaces between the left superior intercostal vein and highest tributary of the left lower azygos vein.

They are usually two or three in number, and join to form a trunk which ends in the right azygos vein or in the left lower azygos. It sometimes receives the left bronchial vein. When this vein is small or altogether wanting, the left superior intercostal vein will extend as low as the sixth intercostal space.

The bronchial veins return the blood from the substance of the lungs, that of the right side opens into the vena azygos major near its termination, that of the left side, into the left superior intercostal vein or left upper azygos vein. It is thus easy to account for the thorough drainage through the superior and inferior venal cava when the improved blood tubes are introduced directly into the right auricle of the heart.

Plate No. 31. THE HUMAN SKIN AND ITS APPENDAGES

(Continued from Page 65)

Sudoriferous or Sweat Glands

The sudoriferous or sweat glands are the organs by which a large portion of the aqueous and gaseous materials are excreted by the skin. They are found in almost every part of this structure, and are situated in small pits in the deep parts of the corium, or more frequently, in the subcutaneous areolar tissue, surrounded by a quantity of adipose tissue, which is plainly seen on the colored supplement.

Serous Membranes

The serous membranes form shut sacs and may be regarded as lymph sacs, from which lymphatic vessels arise by stomata or openings between the epithelial cells. The sac consists of one portion which is supplied to the walls of the cavity which it lines, the parietal portion; and another reflected over the surface of the organ or organs contained in the cavity, the visceral portion.

Synovial Membranes

Synovial membranes, like serous membranes, are connective tissue membranes placed between two movable tissues, so as to diminish friction, as between the two articular ends of the bones forming a movable joint; between a tendon and a bone, where the former glides over the latter; and between the skin and various subcutaneous bony prominences.

Mucous Membrane

Mucous membranes line all those passages by which the internal parts communicate with the external or exterior, and are continuous with the skin at the various orifices of the surface of the body. They are soft and velvety, and very vascular, and their surface is coated over by their secretion, mucus, which is of a tenacious consistence, and serves to protect them from the foreign substances introduced into the body with which they are brought in contact. In structure a mucous membrane is composed of corium and epithelium. The corium is an exceedingly vascular membrane, containing a dense network of capillaries, which lie immediately beneath the epithelium, and are derived from small arteries in the submucous tissue.

By consulting the colored plate the reader will plainly see the capillary loops as they supply the various layers of the skin. The loops represent the arterioles, capillaries, and venules. It is through these small vessels that the preserving solutions must pass, and if they are too constricting in character, they simply prevent the solution from passing through them as it should, thereby depriving some parts of the body of their share. When the fluid fails to pass through these small vessels, putrefactive changes are manifested, for nature is a fine analytical chemist and picks out the flaws in our work with exacting care. She shows us where we have been lacking in the performance of our work by producing putrefactive changes. When these changes take place, it is either owing to the preserving solution being too weak, or our technique is faulty. If the injection is carried on with too much haste, that is, if the pressure exerted for injecting the fluid is too great, an unequal distribution of the fluid takes place due to greater pressure on some parts than on others, and a spotted appearance is the result. The mottled appearance of the skin as the preserving solution passes through the capillaries, is caused by the distention of the capillaries as they fill up the papillae of the skin. By consulting the colored supplement the reader can easily see that papillae as the capillary loops pass through them, and when the fluid distends these the mottled appearance is produced, and this may cause the skin to assume a rough appearance, provided the preserving solution is too stringent in its action on the tissues. This has led many embalmers to over dilute the preserving solution so as to overcome the above mentioned condition. In many instances this over diluted solution is too weak to be classified as a preservative, and putrefactive changes resulting in skin slip are the results. We now have new chemicals at our command that turn the blood a pink color and preserve the skin in its soft natural velvety condition, thereby doing away with that objectionable putty, leaden and ashen color so much objected to by discriminating embalmers.

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